August 14, 1961

Aviation Week and Space Technology

Unfurlable Solar Collector Model Is Developed

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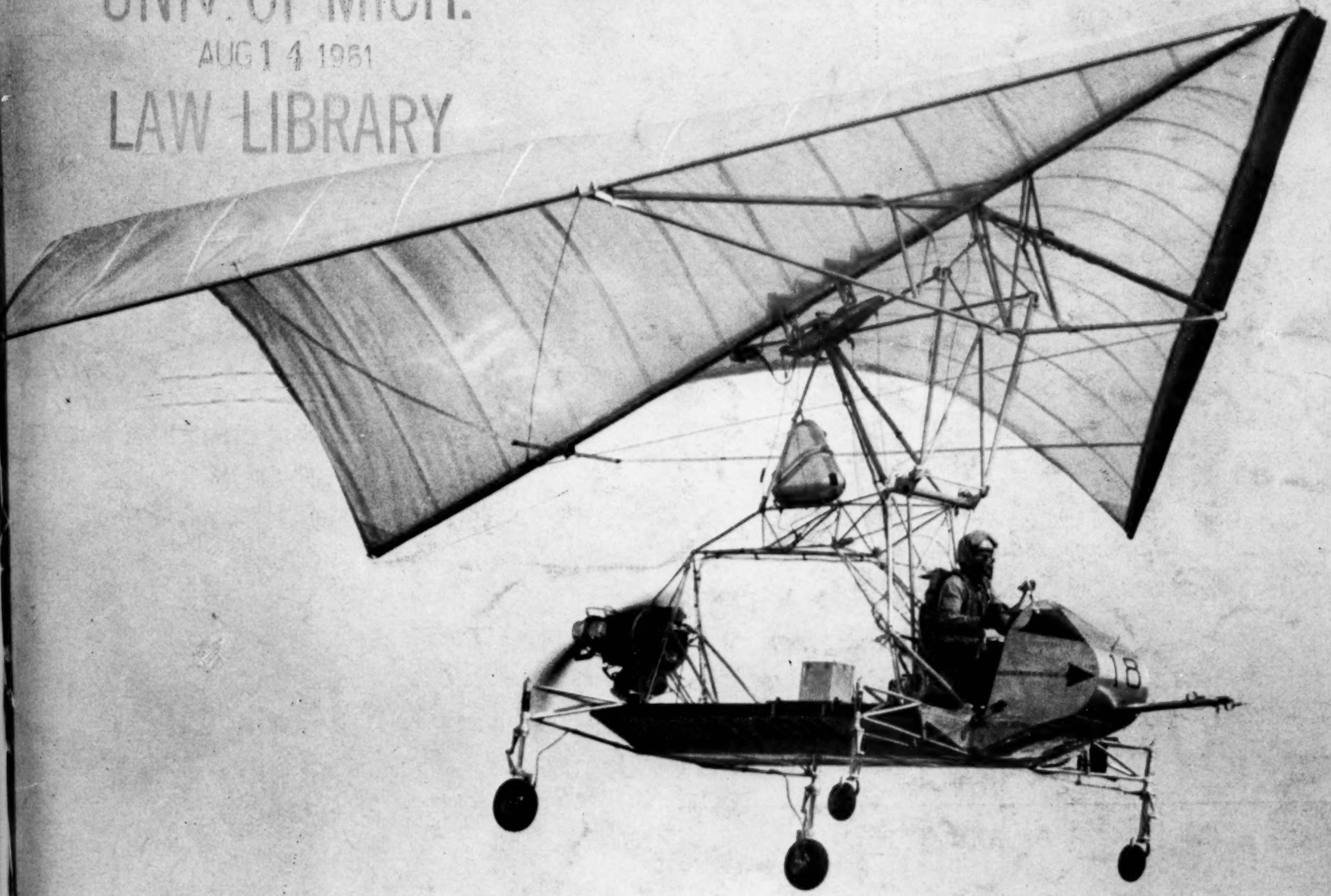
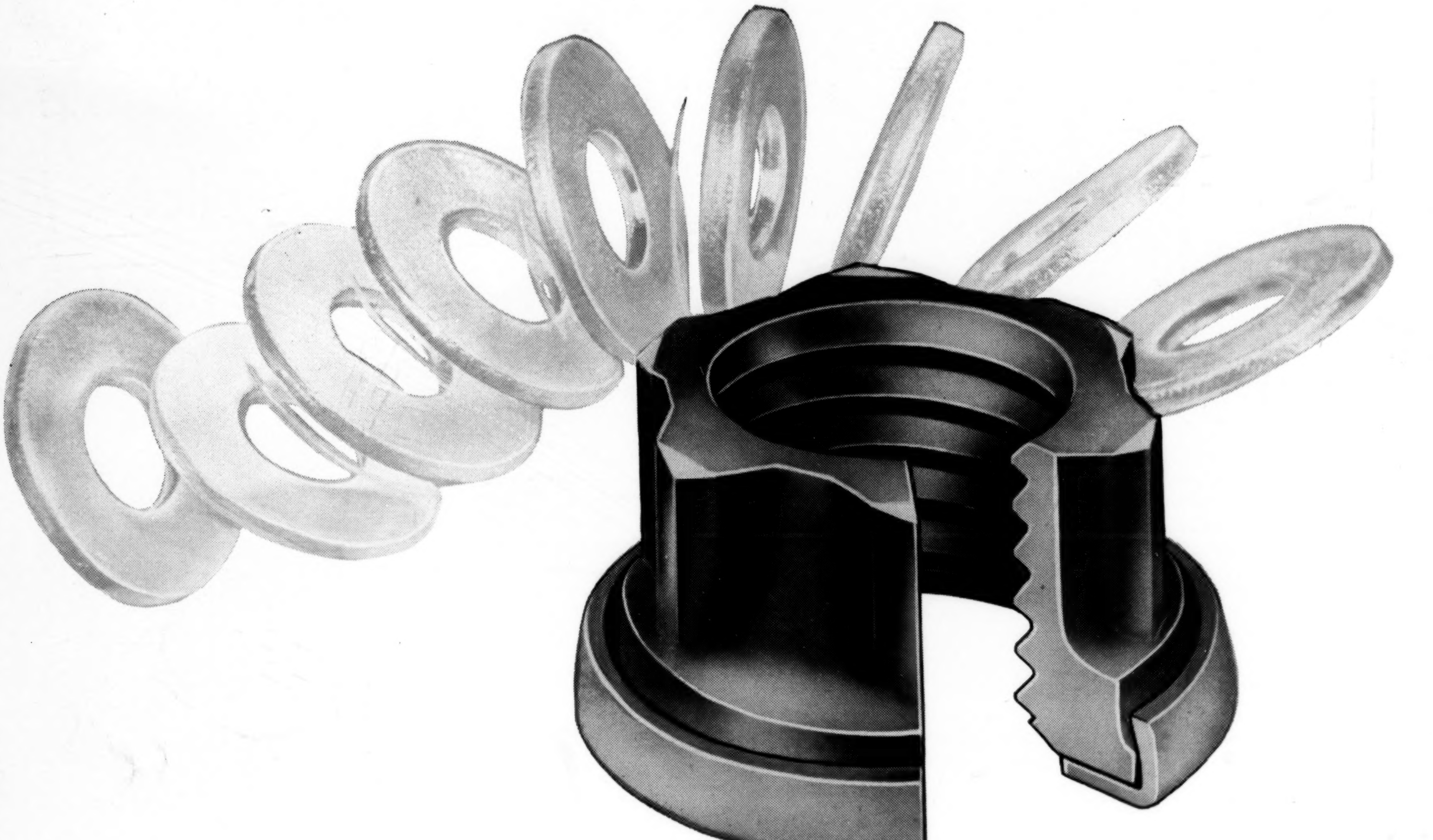


Ryan Rogallo Wing Airplane



HW14

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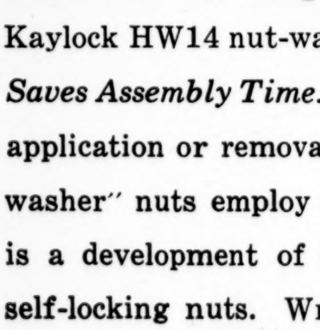
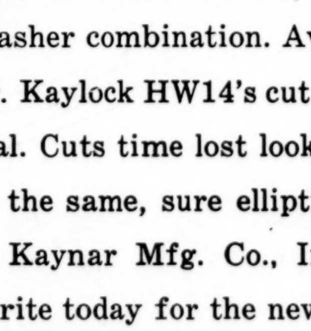
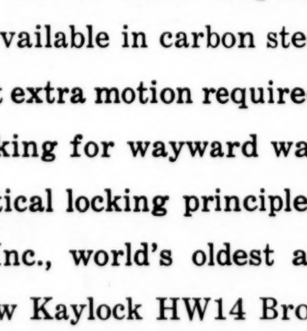


The Kaylock HW14 is available in size -02 (shown above) and in other sizes to -6



View of Kaylock HW14-3 and washer prior to assembly.



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AVIATION CALENDAR

Aug. 22-25—Western Electronic Show and Convention, Cow Palace, San Francisco.

Aug. 23-25—Fourth Biennial Gas Dynamics Symposium, American Rocket Society, Northwestern Technological Institute, Evanston, Ill.

Aug. 24-26—Sixth Annual National Reunion, OX5 Club of America, Allis Hotel, Wichita, Kan.

Aug. 28-30—West Coast Conference of Applied Mechanics, University of Washington, Seattle, Wash.

Aug. 28-30—Air Force/Aerospace Corp.'s Symposium on Ballistic Missile and Aerospace Technology, University of Southern California, Los Angeles, Calif.

Aug. 28-Sept. 1—International Heat Transfer Conference, University of Colorado, Boulder, Colo.

Aug. 28-Sept. 1—Third International Symposium on Rockets and Astronautics, Japanese Rocket Society, Tokyo, Japan.

Aug. 30-Sept. 1—Second Annual Bionics Symposium, General Electric Advanced Electronics Center, Cornell University, Ithaca, N. Y.

Aug. 30-Sept. 1—Third Annual Semiconductor Conference, American Institute of Mining, Metallurgical and Petroleum Engineers, Ambassador Hotel, Los Angeles.

Sept. 4-10—1961 Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, England.

Sept. 4-14—Eighth Anglo-American Aeronautical Conference, Royal Aeronautical Society and Institute of the Aerospace

(*Continued on page 6*)

AVIATION WEEK and Space Technology

August 14, 1961

Vol. 75, No. 7

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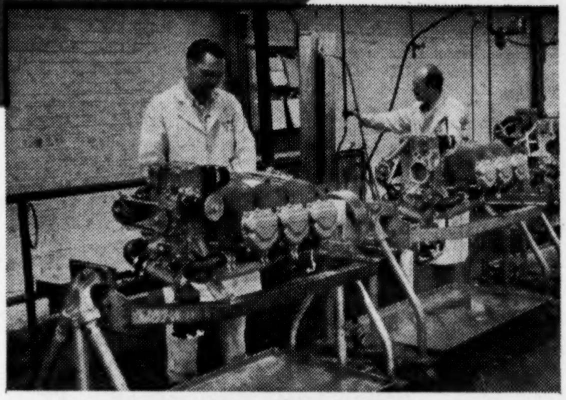

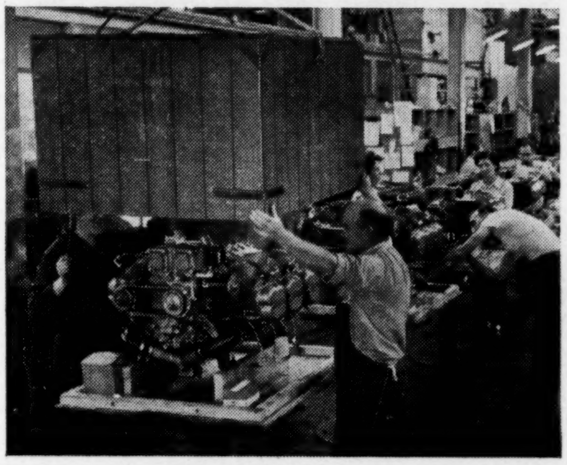

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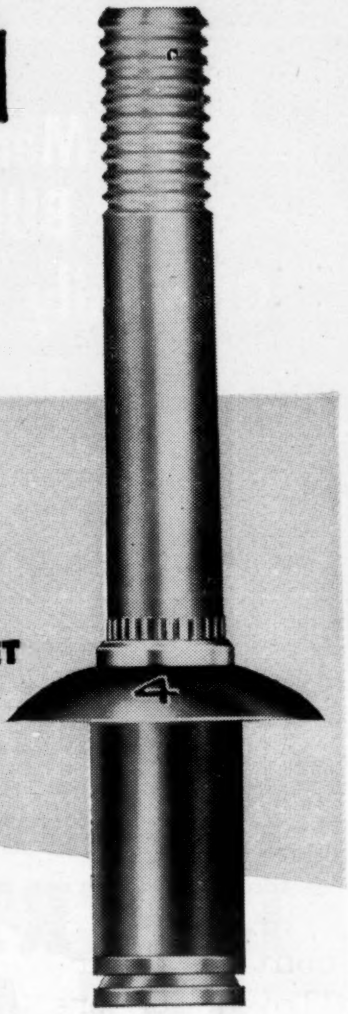

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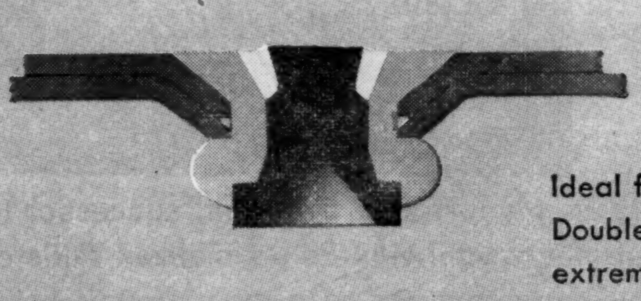

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AVIATION CALENDAR

(*Continued from page 5*)

Sciences, London, England. Wilbur Wright Memorial Lecture, Sept. 12.

Sept. 5-8—16th National Conference, Assn. for Computing Machinery and First International Data Processing Exhibit, Statler-Hilton Hotel, Los Angeles, Calif.

Sept. 6-8—National Symposium on Space Electronics and Telemetry, Institute of Radio Engineers, University of New Mexico, Albuquerque, N. M.

Sept. 6-8—Joint Nuclear Instrumentation Symposium, North Carolina State College, Raleigh, N. C. Sponsors: American Institute of Electrical Engineers; Instrument Society of America; IRE.

Sept. 7-8—Fall Meeting, Western States Section/The Combustion Institute, University of California, Berkeley, Calif.

Sept. 10-12—National Convention, National Aeronautic Assn., Westbury, N. Y.

Sept. 13-14—International Operations and Maintenance Symposium, Airwork Corp., Millville, N. J.

Sept. 13-15—16th Annual Meeting, Armed Forces Chemical Assn., Statler-Hilton Hotel, Washington, D. C.

Sept. 14-15—Ninth Annual Joint Societies Engineering and Management Conference, IRE, Hotel Roosevelt, New York.

Sept. 14-15—Conference on Technical-Scientific Communications, Institute of Radio Engineers, Bellevue-Stratford Hotel, Philadelphia, Pa.

Sept. 15-17—Annual Convention, National Assn. of State Aviation Officials, Miami Beach, Fla.

Sept. 20-21—Industrial Electronics Symposium, Institute of Radio Engineers, Bradford Hotel, Boston, Mass.

Sept. 20-24—National Convention and Aerospace Panorama, Air Force Assn., Philadelphia, Pa.

Sept. 26-28—Annual Convention, National Business Aircraft Assn., Mayo Hotel, Tulsa, Okla.

Sept. 29-30—Society of Experimental Test Pilots' Fifth Annual Symposium and Awards Banquet, Beverly-Hilton Hotel, Beverly Hills, Calif.

Oct. 2-4—Seventh National Communications Symposium, Institute of Radio Engineers, Hotel Utica, Utica, N. Y.

Oct. 2-7—12th International Astronautical Congress, Washington, D. C.

Oct. 3-5—National Airports Conference, University of Oklahoma, Norman, Okla.

Oct. 9-13—National Aerospace Engineering & Manufacturing Meeting, Society of Automotive Engineers, Ambassador Hotel, Los Angeles, Calif.

Oct. 9-15—American Rocket Society's 16th Annual Meeting & Space Flight Report to the Nation, Coliseum, New York, N. Y.

Oct. 14-22—Federation Aeronautique Internationale 1961 General Conference, Hotel Quintandinha, Rio de Janeiro, Brazil.

Oct. 23-24—Joint Meeting, Canadian Aeronautical Institute/Institute of the Aerospace Sciences, Ottawa, Canada.

Oct. 23-27—17th Annual General Meeting, International Air Transport Assn., Sydney, Australia.

Oct. 24-26—International Symposium on Aero-Space Nuclear Propulsion, Institute of Radio Engineers, Riviera Hotel, Las Vegas, Nev.

August 14, 1961

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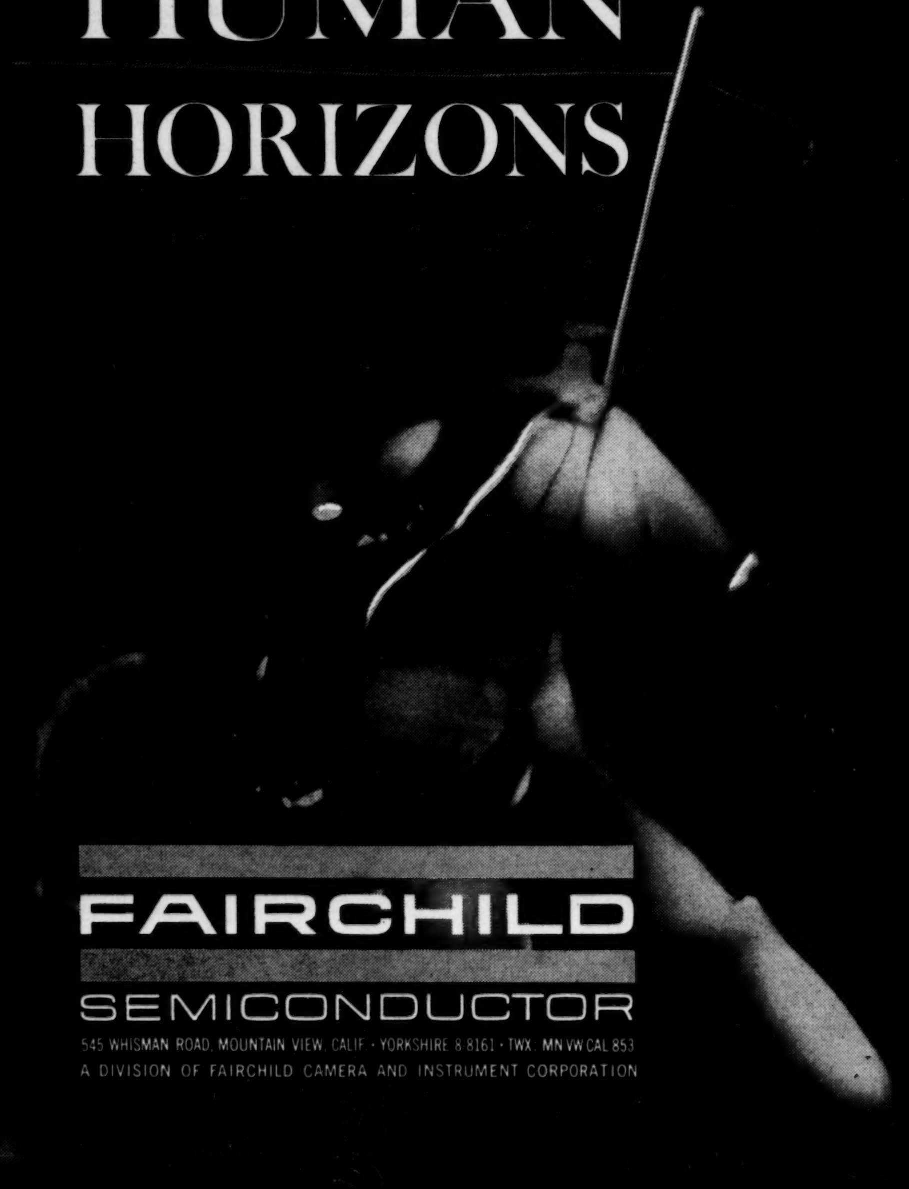

EDITORIAL

Vostok II's Warning

The latest Soviet feat of hurling Vostok II and its occupant, Gherman Titov, into 17 orbital swings around the earth and then recovering both the capsule and its human cargo safely and precisely according to predetermined plan provides a sobering yardstick by which to measure the relative progress in space technology on both sides of the Iron Curtain.

The flight of Vostok II and Maj. Titov is a scientific achievement of the first magnitude. The Soviet scientists responsible for it deserve unqualified congratulations for passing another historic milestone in man's conquest of space. Some 7,000 of these technicians recently were awarded high Soviet decorations for their work, although communist policy still cloaks them in anonymity.

There were many laughs in this country when Nikita Khrushchev also awarded himself a decoration for these space achievements, but this is hardly as comical as some of our sophisticates would have us believe. For it was the top-level support of the Soviet Union's political leaders that in large measure gave the Russian space scientists their great opportunity to achieve these earth-shaking results, and it has been the homespun, corn pone approach of our own top national leaders—including many of the top scientists who recently have basked in politically appointed jobs—that labeled space technology as an effort of little importance and low national priority. This has hobbled and hamstrung our own scientific and technical talent more than anything else and is the major reason why we still run second in this field.

Conservative Drag

It is worth recalling that only last January, outgoing President Eisenhower expressed serious doubts over the value of a man-in-space program. Reflecting the ultraconservatism that has now been ballyhooed into a homegrown American virtue, he then recommended wiping out the funds for the Apollo program until the Mercury program had been completed, whenever that might be. It also is worth recalling the scientific advice that President Kennedy first received from his top scientist, Jerome Wiesner, who led the "kill the Mercury" wing of these scientific politicians whose opinions have been refuted so often in the past decade both by technology and politics.

With the handicap of this type of leadership, it is difficult to see how our abundance of technical talent and industrial resources could achieve anything better than second place in the space race. The cost of a medal to Nikita Khrushchev is a small price to pay for the support he has given his space technologists. We would be in far better shape today if the conduct of our national leadership over the past six years deserved medals of this kind. And what kind of a medal should be awarded that eminent Detroit humorist, Charles E. Wilson, who as Secretary of Defense firmly squashed all military attempts to lay sound foundations for space research in the years just before Sputnik I?

Major significance of Maj. Titov's flight lies in the field of bioastronautics, where the U.S. has yet to settle its inter-agency power fights, much less lay the foundations for a sound national program. The 25-hr. orbital flight of Vostok II plus its pad time was a striking demonstration of the life support system the Soviets have developed and perfected to routine operational use. According to their technical literature, this system in the Vostok capsule will support human life for a maximum of 10 days and is a regenerative type of system employing super-oxides.

Design Limits

A 10-day life support system would be ample for a quick round trip to the moon. In contrast, the Mercury capsule has a life support system which, including pad time, would make a 24-hr. orbital flight a risky business, and certainly prohibits use of the capsule for any mission deeper into space. Even preliminary designs for the Apollo moon vehicles are still being based on life support systems that depend on storing oxygen.

This country has ample resources in properly trained medical researchers, laboratory and test facilities and experience to operate an effective bioastronautics program. But the fight for power in this area between NASA and the Air Force and the disorganization of these facilities within the military sphere have slowed progress.

It may well be that Vostok II's flight has sounded the warning that it is impossible for the U.S. lunar program recently established by President Kennedy to beat the Russians to a manned landing on the moon. Even if this is true, there is no reason either to abandon the Kennedy moon program or to relax our efforts across the board in space technology.

But it must be evident even to the most obtuse legislator, Detroit motor magnate, or Gettysburg farmer, that the full force of the Soviet technical challenge that has been increasing in intensity since 1955 is now upon us. It must also be evident that these Soviet space, missile and aeronautical achievements are neither conjuring tricks designed only to deceive the West nor are they mirages seen only by Americans supposedly interested solely in raising military budgets or sweetening the scientific pot.

It is evident that they are an integral part of the challenge to the existence of this or any other free nation by Communism and that our national leadership has been incredibly naive in failing to recognize this long before a Red Air Force major orbited the earth 17 times and returned successfully to Russian soil.

—Robert Hotz

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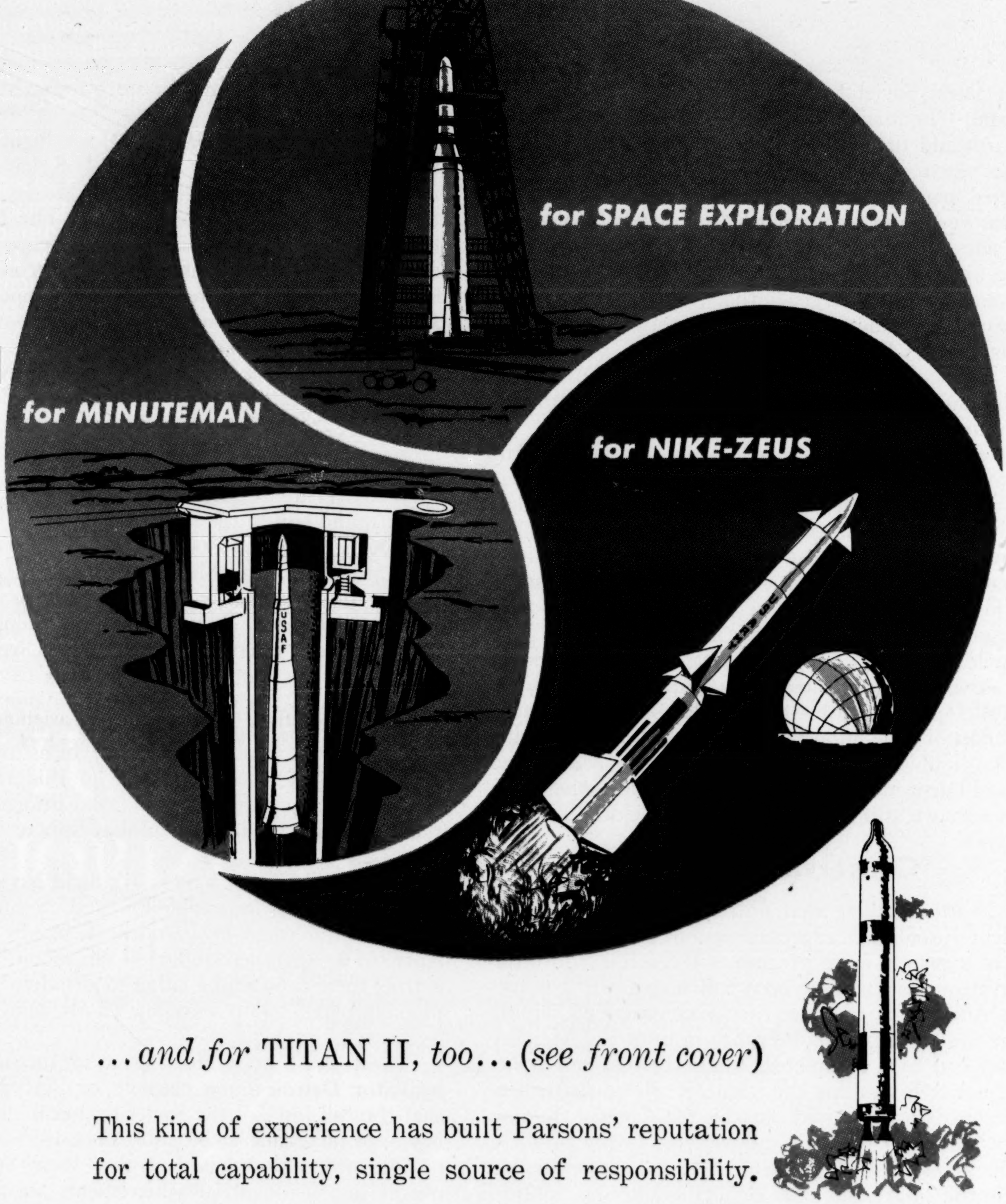

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Elmer P. Wheaton, acting vice president-engineering, Douglas Aircraft Co., Inc., Santa Monica, Calif., assuming the responsibilities of Vice President **Edward F. Burton**, on leave due to illness.

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Richard A. Dick, a vice president, Pacific Airmotive Corp., Burbank, Calif., and head of the newly established International Division, which will absorb Pacair, Inc., a PAC subsidiary.

Dr. Raymond L. Garman, vice president and chief scientist, General Precision, Inc., Tarrytown, N. Y., subsidiary of General Precision Equipment Corp., and **David Balber**, director of advanced product development.

E. F. Coy, vice president and director of marketing, Military Products Division, Hoffman Electronics Corp., Los Angeles, Calif.

Dr. Carl E. Barnes, vice president-research, FMC Corp., San Jose, Calif.

Andrew J. Phelan, vice president and comptroller, Pan American-Grace Airways, Inc.

Clarence E. Watson, vice president-business administration, CBS Laboratories, Stamford, Conn.

I. C. Maust, vice president and general manager, The Bendix Corp.'s Micrometrical Manufacturing Co., Ann Arbor, Mich.

Edward Bachorik, executive vice president, Allied Control Co., Inc., New York, N. Y.

Air Vice-Marshal Edouard Michael Fitzfrederick Grundy, Commandant-General, Royal Air Force Regiment.

Col. John G. Redmon, USA, Deputy Commander, Army, at Pacific Missile Range Headquarters, Pt. Mugu, Calif.

(*Continued on page* 131)

INDUSTRY OBSERVER

► Air Force and Boeing hope to eliminate suborbital flights of Dyna-Soar from the accelerated research and development program and go directly to orbital flights, using the Saturn booster. This would cut 2½ yr. from Dyna-Soar's test schedule and give USAF a manned space vehicle before National Aeronautics and Space Administration's Apollo is ready. It also would eliminate the Martin Titan II booster from the Dyna-Soar program. Return to earth from orbit is considered a safer and easier task for a Dyna-Soar pilot than return from suborbital trajectories.

► Swiss air force technical team is scheduled to visit the U. S. soon to evaluate several types of air-to-air missiles for possible use on its planned fleet of Dassault Mirage III interceptors.

► Hughes has developed a side-looking radar with 20-ft. resolution in 100 mi. which could be installed on the B-52 or specified for the B-70. It is ready for production, but no order has yet been placed.

► Weser Flugzeugbau is considering conversion of its DFS 582 high-altitude glider to a continuous power configuration in order to gain additional range and altitude. The equivalent of a small-scale U-2 (AW May 29, p. 26 and June 19, p. 99), DFS 582 is still in the development stage. Initial plans call for use of a 3,000-lb. thrust Pratt & Whitney JT12A-6 turbojet for powered takeoff, climb to glide altitude of 60,000 ft. and engine-on landing. Unpowered loiter capability of this configuration is approximately 4 hr., with a maximum range of 1,800 mi.

► Flight of a Rhesus monkey with biological telemetry system implanted in its chest, originally scheduled from Cape Canaveral on an Atlas-E last month (AW May 15, p. 23), has slipped until later this summer. The test will be made to prove the validity of using internal animal instrumentation in space flight.

► Egypt is making a determined effort to create a strong aviation industry, including design and production of Mach 2.5-class interceptors. To obtain the required technical knowledge and experience, the Egyptian government is offering leading West German designers and engineers salaries well above their present scale, plus attractive fringe benefits and 5-yr. contracts.

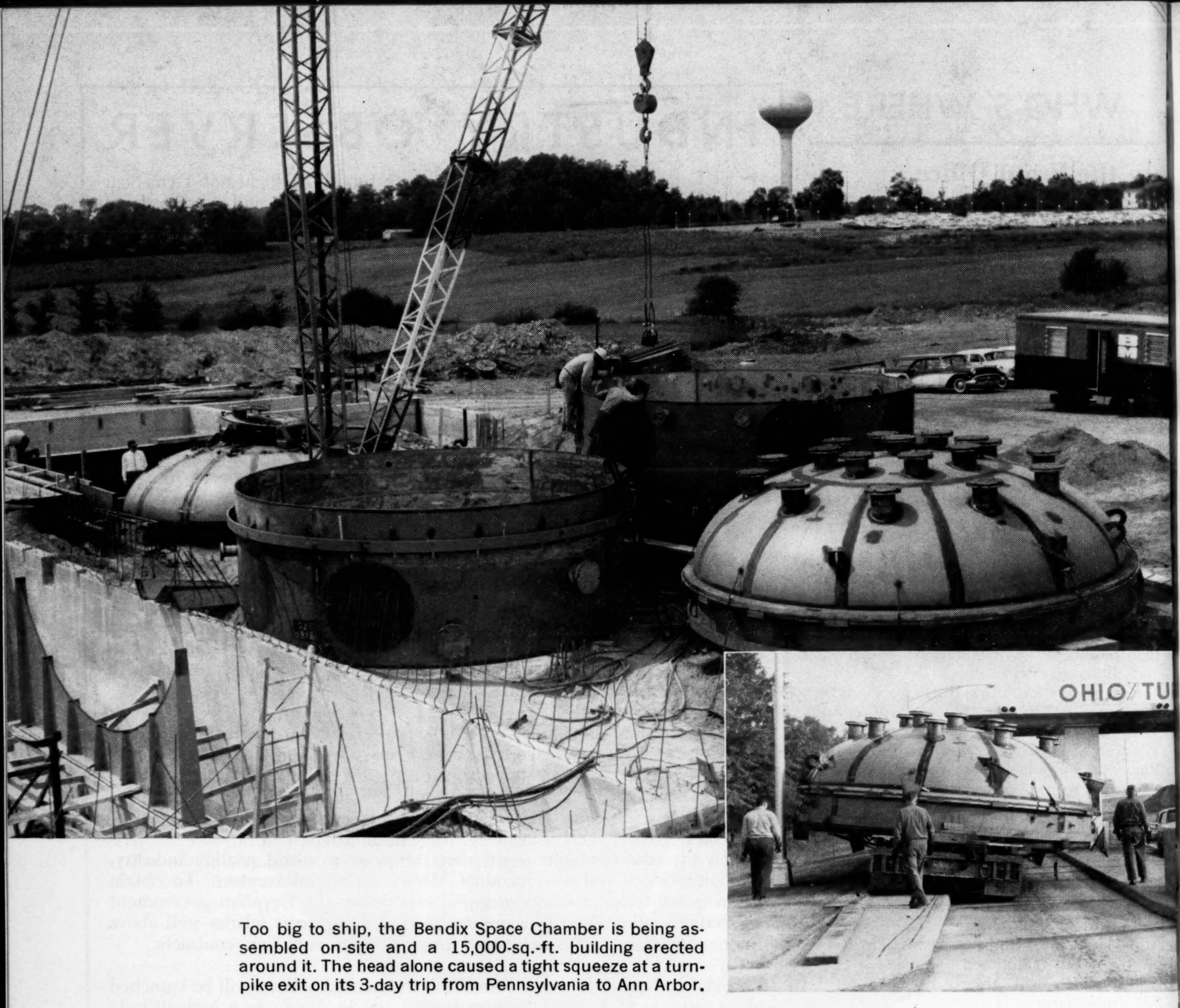
► Air Force-Denver Research Institute instrumented balloon will be launched to an altitude of 100,000 ft. soon from a site in Alaska in a high-altitude radiometric study.

► Advanced Research Projects Agency has suspended and may discard plans for ARPA 162-61 (formerly called Project Lofter), a satellite warning system for infrared and ultraviolet detection of ballistic missile launchings. Decision to delay the project—influenced by technical difficulties in the concept, lack of necessary basic information and departure from ARPA of the program's leading advocates—has disturbed a number of companies which rushed costly proposals and supplementary data in response to a USAF Aeronautical Systems Division request (AW Apr. 3, p. 33). The competition was for four of more than a dozen separate planned ARPA 162-61 tasks. Air Proving Ground Center had conducted a competition for the 162-61 vehicle.

► Management responsibility for developing range instrumentation at Cape Canaveral will be transferred soon from Air Force Ballistic Systems Division to Electronics Systems Division.

► Minuteman tests run in altitude chambers permitted nozzle design changes in time to solve erosion problems before flight tests began. Gimbaled Minuteman nozzles encountered short life problems because of erosion from the sand blasting effect of aluminum particles in the exhaust stream.

► Total facility cost of the Titan II storable fuel ICBM runs one third the cost for the Titan I using cryogenic liquid propellants. Titan launching from a Vandenberg AFB silo produced temperatures and sound levels—over 3,000F and 145 db.—very close to those anticipated in designing the missile and silo.



Too big to ship, the Bendix Space Chamber is being assembled on-site and a 15,000-sq.-ft. building erected around it. The head alone caused a tight squeeze at a turnpike exit on its 3-day trip from Pennsylvania to Ann Arbor.

PROGRESS REPORT #2: BENDIX SPACE LABORATORY

On-site fabrication of a new 20′ x 27′ thermal vacuum chamber capable of accommodating full-sized spacecraft and capsules began at Ann Arbor on 12 July. The installation of the chamber, which will be capable of 10^{-8} mm Hg vacuum and of simulating the sun's intense radiation and the low absolute temperature of space is on schedule and will be in operation this fall. Our rapidly expanding space laboratory offers new technical challenges and career opportunities to experienced senior personnel.

Qualified applicants will receive consideration for employment without regard to race, creed, color or national origin.

BENDIX SYSTEMS DIVISION
ANN ARBOR, MICHIGAN

THE Bendix CORPORATION

Washington Roundup

Space Conflict

Conflict between the military services—chiefly Air Force—and the National Aeronautics and Space Administration over respective shares in the national space program is growing in spite of all the joint committees and appearances of harmony.

USAF particularly is concerned over the military implications of space feats such as the Vostok II flight (see p. 31) and over the pace of NASA's work. Most recent irritant is a NASA contract with Aerospace Corp. (see p. 29), which was created chiefly to handle USAF's technical missile and space problems.

Top Air Force officials approved the contract, as they must whenever Aerospace accepts outside work, but many working-level USAF spacemen consider it a sell-out and have said so.

With little fanfare, the Army Map Service has completed the first U.S. topographic map of the moon. It now is refining the map and making a study of the moon's terrain. The map will form the basis of a large scale map that National Aeronautics and Space Administration hopes to complete by about 1964. The one just completed was two years in the making.

Non-Profit Contracting

Budget Bureau's comprehensive study of government contracting with non-profit organizations, which President Kennedy requested, is expected to hold off any drastic action by Congress. The review is to be completed by Dec. 1.

Congressional disapproval of contracting for technical, management and research services has grown as the practice has mushroomed, particularly in the Defense Department. House appropriations committee threatened earlier this year to require that these organizations pay the same salaries that government does.

Budget Bureau's study will concentrate on whether as many people are required to oversee the non-profit group's work as would be needed to do the work itself; whether government salaries should be increased or non-profit salaries lowered; what criteria should be used to decide whether work should be done by government or farmed out; how non-profit contractors should be selected, particularly when new corporations are formed specifically to do a government job; what standards should be used for fees and cost allowances.

McNamara's End Run

Defense Secretary Robert McNamara has been encouraging interviews with newsmen who do not cover the Pentagon regularly in an attempt to improve his public image. He feels that the Pentagon regulars too often go to dissidents in the military services for information when they encounter reluctance to talk in the higher civilian echelons, where political awareness is greater.

Although McNamara has been a popular witness on Capitol Hill, his press relations got off to a bad start with the famous "missile gap" background briefing. His swift moves to assure civilian control of the department also led to stories of military unhappiness with his tactics. His countermove has resulted in several dozen interviews by "outsiders," and has produced favorable articles in national magazines.

Congressmen are considering holding joint sessions of the foreign relations, armed services, atomic energy and appropriations committees to hear the Administration's basic presentation on national security aspects of the Fiscal 1963 budget requests next January. This would be a big time-saver both for Congress and for officials in the executive branch.

Defense Secretary McNamara estimates he spent the equivalent of 20 working days giving testimony to congressional committees and 10 days preparing it in his first six months in office. Much of the time is spent saying the same things to different people.

Amiable Russians

State Department officials have been impressed by the extreme friendliness of the Russian delegates who negotiated the New York-Moscow bilateral air transport agreement. Bitterness over the Berlin issue has been absent from the talks.

Russia also failed to press its desire for traffic rights beyond New York to Havana and Latin America. They are expected to do this once the New York-Moscow service has been given a fair test. The U.S. will counter with a request for trans-Siberian rights—a route between Moscow and Tokyo.

Rep. B. F. Sisk's request for congressional action on the aircraft noise problem has the aspects of a special interest pleading. "An airplane's sonic boom once defrocked my chickens," he said. "I've got witnesses."

Air Force changed the title of the Strategic Air Command commander's office at Vandenberg AFB, Calif., to commander, Strategic Aerospace Division, Strategic Air Command, until it discovered that this formed the acronym SAD-SAC. It quickly settled for STRATAD instead.

—Washington Staff

Soviet Gains Blunt U.S. Bomber Potential

McNamara bases his downgrading of manned aircraft on an assessment of Russian anti-aircraft advances.

By Larry Booda

Washington—Positive evidence that Russian advances in anti-aircraft technology would make bomber penetration of key Soviet targets ineffective is the principal reason for the stubborn attitude of Defense Secretary Robert S. McNamara and his advisers favoring the phasing out of manned bombers, despite heavy congressional pressure to continue B-52 production.

Soviet Union has been engaged in a massive air defense effort which includes new, longer range radars, infrared detection, ground-to-air missiles able to reach to 100,000 ft. and air-to-air missiles.

Even allowing for a 3-yr. Russian lag behind U. S. in air defense technical capabilities, a gap which intelligence sources say is rapidly shrinking, a mass raid of B-47s and B-52s in the near future would result in attrition of 75 to 90%, according to McNamara's advisers.

Noting that in the past the individual services have interpreted intelligence information in a manner to support their own weapons ideas, McNamara recently merged the intelligence operations in order to obtain more balanced appraisals. A new assessment of Russian air defense strength was one of the main reasons for the change.

In comparing capabilities of the U. S. with those of the Russians, U. S. foreign technology analysts have considered these factors:

- **Progress in infrared detection** and tracking for terminal intercept at ranges of more than 30 mi. will permit replacement of some radar in fighter aircraft and ground-to-air-missiles. Ground radar, although necessary for long-range acquisition, will not have to be as accurate, thus will be less costly. Infrared equipment is several orders of magnitude less complex than radar.
- **Mach 3 bomber** such as the B-70, in fact any supersonic aircraft, becomes a strong generator of electromagnetic radiation in the 4-11 micron (infrared) wavelength range.
- **There is a finite limit** to the radar jamming capabilities of bombers and the numbers of radar decoys, such as the Quail, and infrared decoys they can carry. Random pulse-frequency diversity radar, which the Russians are assessed as having or will soon have, is almost jam and decoy proof, requiring a large mass of equipment to overcome.
- **Russia displayed** at least four air-to-air missiles at the July Tushino air show. One type resembled the infrared homing Sidewinder, probably copied from missiles recovered by Chinese Communists after they were fired by the Nationalist Chinese over the mainland and missed their targets. Another was in the class of the radar-guided Sparrow III and GAR 3 and 4 Falcon. Two others appear to be longer range versions, one of which has a two-stage configuration, placing them in the class of the GAR 9 and Eagle, with ranges to 40 mi. (AW July 24, p. 29).
- **Two kinds of surface-to-air** missiles in the Nike Hercules class, one the "Chevron" and the other the longer range, higher altitude "House of David," have been paraded in Red Square and pictured in action. They are in mass production.
- **New generation of Soviet fighters**, capable of steady supersonic flight at 65,000 ft. and zoom capabilities much higher than that, is being produced. The Russian world altitude record of 112,000 ft. set by the delta-wing Sukhoi E-66 fighter, is held as the basis for assigning a capability of building engines for higher altitude operations in the future.

In scanning the mass of technical literature published in Russian journals, U. S. foreign technology personnel have become acutely aware that the Russians are rapidly approaching the U. S. in miniaturization of electronic components. Compact circuitry is an essential part of anti-aircraft missiles.

Soviet Tests Assumed

Analysts assume that the underground test explosions announced by the Russians have actually been clandestine testing of nuclear weapons with yields of less than 100 kilotons. By being able to prove weapon designs, Russia is assessed the ability to produce low yield nuclear warheads for air defense missiles in one or two years. The U. S. already has this capability.

An example of Russian air defense effort is its protective ring around Moscow. There is an inner ring of missiles, another ring of longer range missiles and an outer ring at 40 to 50 mi. of fighter airfields.

The two principal factors considered in giving the Russians an increasingly effective air defense 2-3 yr. from now are the emergence of infrared guidance and the low yield nuclear warhead. The Russians are known to be making rapid strides in both fields.

Until recently, the concentration of effort in infrared had been in short-range detection based on the exhausts of jet engines. These exhausts radiate sufficient energy in the 4-5 micron wavelength range that Sidewinder missiles, for instance, can enter an engine tail-pipe to destroy an aircraft.

As the result of recent developments in the 9-11 micron region, however, effective equipment has been built to take the place of radar in aircraft for acquisition of targets up to 32 mi. Radiation at these wavelengths penetrates haze much further because of the "window" in that region. Against high flying aircraft, which will be above all but the most unusual cloud levels, infrared will have almost an all-weather capability. Air-to-air missiles will not be fitted with this type of equipment, since they need only short-range ability because they are guided initially by the launching aircraft.

Surface-to-air missiles, however, especially those that will penetrate to 70,000 ft., could make use of the longer wavelength gear.

Ideal Infrared Target

A Mach 3 aircraft, flying at 2,000 mph., will operate at such elevated skin temperatures that it will "glow" brilliantly in the entire infrared electromagnetic wavelength range. Scientists have stated that if they wanted to create an ideal target in the air, this is the approach they would take. At 2,000 mph. at 70,000 ft., there will be points on an aircraft where temperatures will build to 375F.

In going to a nuclear warhead for anti-aircraft missiles, there is a great reduction in requirements for accuracy in hitting or closely missing a target. For instance, nuclear yields of only the equivalent of 10 tons of TNT or 0.01 kilotons are now possible. This yield creates a fireball 200 ft. in diameter, but the kill radius extends much farther than that. The GAR 11 Falcon is such a weapon. The launching aircraft performs an intercept by using pulse-Doppler radar to illuminate the target. Breakaway is made simple because the radar can point 75 deg. away from straight ahead.

The U. S. bombers themselves have tended to create an aura of doubt as to just how well they could perform their missions. B-47s, which carry no penetration aids such as Quail or Hound

Dog, are sliding fast down the obsolescence curve. Training missions are limited because the Air Force dares not allow too many nuclear delivery maneuvers to be performed due to weakening of the wing spars, whose fatigue life is limited.

B-47 pilots are limited to 20-25 hr. of flight per month, which is considered the bare minimum to retain proficiency in ordinary flight, not considering the complexities of combat missions.

Defense had planned to reduce the number of B-47 wings from 20 to 13 in Fiscal 1961 and even fewer in 1962. Before the Berlin crisis, McNamara asked the Joint Chiefs of Staff for an opinion on halting this phasedown. An Air Force study recommended that the phasedown be halted at 13 wings. There was unanimous approval by the Joint Chiefs, and McNamara concurred early in June.

In attempting to change the mission profiles for B-52s, difficulties have developed. In order to give the B-52 a penetration aid which would clear a path ahead with nuclear explosions, the Hound Dog low supersonic, air-breathing missile was developed. It was planned to carry four or six of these weapons.

Then, as a further measure to allow the B-52 to stay away from Russian defenses, the Skybolt air-launched ballistic missile was designed. It is in early stages of development.

To extend range, large tanks were hung on the bomber's wingtips. In the G and H models, a "wet wing," or fuel-carrying wing, was installed.

Parameters Changed

On top of all this, the mission parameters were changed to include low-altitude penetration to avoid radar detection by flying under its coverage.

Hanging the tanks and missiles on an existing wing changed the dynamic characteristics, particularly during full gross weight takeoffs and aerial refueling, to such an extent that serious fatigue problems were created in the wing spars. Low-altitude missions also flexed the wings in greater magnitude and different frequencies, compounding the problem.

Working on a crash program as a result, the Aeronautical Systems Division at Wright-Patterson AFB, Ohio, in conjunction with Boeing-Wichita, is conducting an exhaustive series of tests to determine what wing fixes are needed to overcome the extra stresses. Meanwhile, lighter loads must be carried.

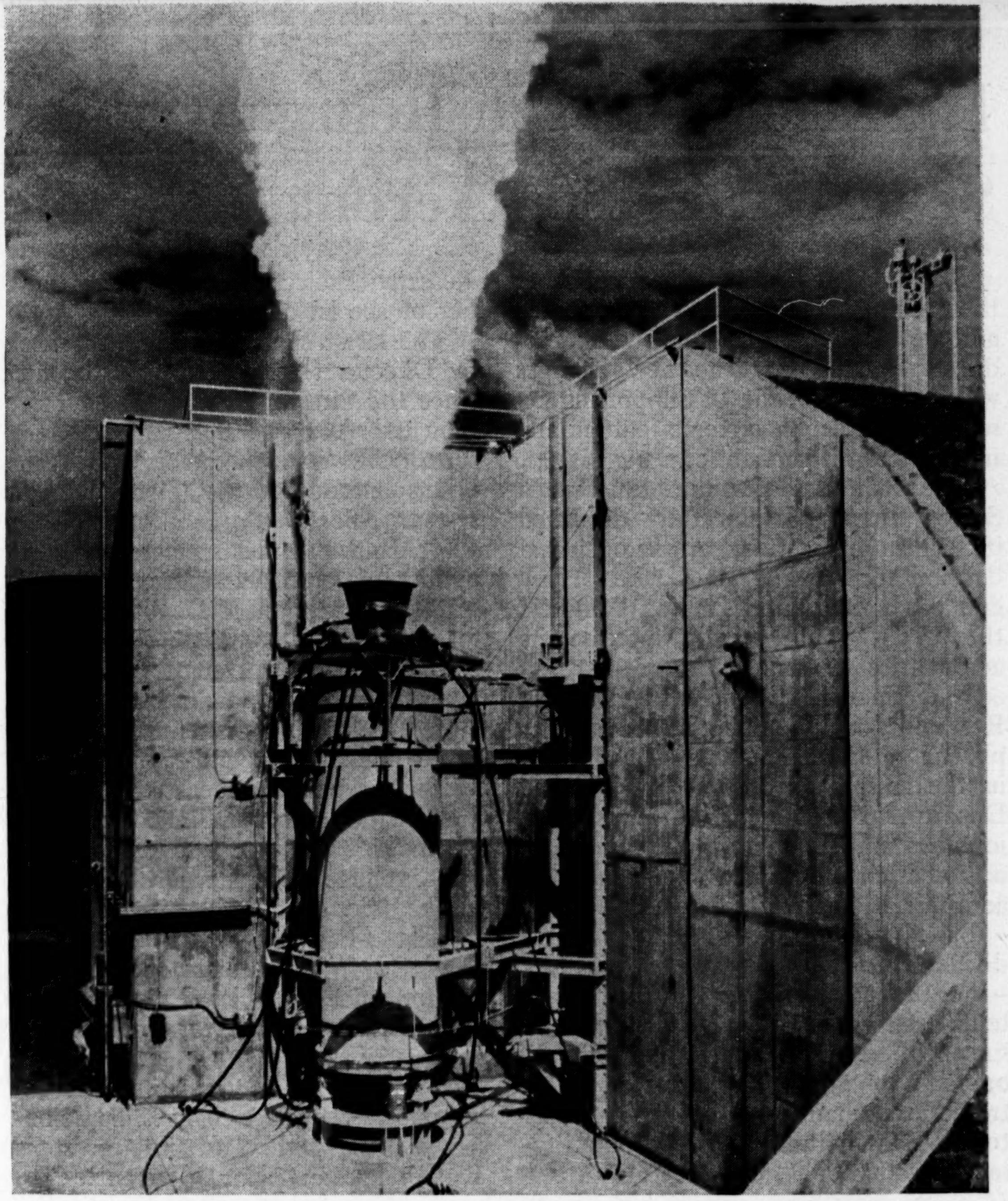
As a result of comparison of U. S. and Russian technologies combined with strategic intelligence inputs, Defense officials determined that the B-70 was simply "overtaken by events." If that aircraft had been pushed as a complete weapon system from its inception 5 yr. ago, it could have been operational in late 1962. However, the project was subjected to what Air Force officers describe as a series of "yo-yo" budget fluctuations.

Subsystem designs for the B-70 as a complete weapon system are now 5 yr. old. If development of more than just the airframe and navigation system were ordered, a complete redesign program would have to be instituted.

In agreeing to the building of several flight articles, McNamara conceded that the state of the art in the supersonic flight regime deserved further investigation. He also was aware of the realities of politics—where a hard core of big bomber advocates within the Air Force, backed by active supporters outside the service, are trying to force his hand not only in the case of the B-70 but also in the purchase of additional B-58 and B-52 bombers.

McNamara is expected to wait out the current political furor over manned bombers, and, if need be, reveal some of the technical and intelligence reasons for his stand.

He also is depending on an increase in the reliability, accuracy and numbers of ballistic missiles. He is depending on Atlas as an interim ICBM, with Titan and Minuteman beginning to take over next year along with increasing numbers of submarine-launched Polaris missiles deployed at sea. Minuteman and Polaris will reach peak strength in 1965 and 1966, with their force levels remaining dominant through 1970.



Large Segmented Solid Rocket Fired

High mass-fraction of 88%, burning time of 80 sec. and thrust of more than 200,000 lb. characterized United Technology Corp.'s Aug. 5 firing of a tapered, 26.5-ft.-long solid propellant motor for the National Aeronautics and Space Administration. Motor, with a propellant web thickness of 26 in., had a base diameter of 86 in. and a narrow-end diameter of 76 in. In a minor test objective, the nozzle cone was fitted with two ports, with Freon injected through one of them to study secondary injection for thrust vector control (AW Mar. 20, p. 55). Since only one valve was available at test time, second port was plugged. About 45 sec. through the firing, the plugged port eroded and the cone burned through. United Technology and NASA, however, considered the test 98% successful. Center section of the three-segment motor, which was assembled on site just before firing, contained more than 55,000 lb. of propellant. NASA said this was the largest single piece of propellant ever manufactured in the U. S.

Defense Research Reorganization Seen Weakening Aeronautics Role

Washington—Latest reorganization of the Defense Department's top research and development office last week produced charges that the new changes will weaken the role of supporting research for weapon systems—particularly in the field of aeronautics.

The change comes at a time when Soviet Russia has forcefully displayed its continuing interest in aeronautical development and a time when Navy and other officials are telling Congress the U. S. should greatly increase its aeronautical research efforts (see p. 29).

The office of the Director of Defense Research and Engineering, which is playing an increasingly dominant role in the research sponsored by Defense Department itself and the military services, has undergone a number of organizational changes since the change of administrations last January.

Basically, however, it has always been divided into two main groups of offices—those for various types of weapon systems (strategic, tactical, etc.) and the so-called technical offices for various branches of supporting research (electronics, aeronautics, etc.). The directorate also includes the Weapon Systems Evaluation Group, the Advanced Research Projects Agency and a number of special offices.

The latest change, ordered last week by Director Harold Brown, is the first since the directorate was created more than two years ago that removes some supporting research offices from the others and lumps them with weapon systems offices.

Dr. Brown's order removed the aeronautics and ordnance research functions from the direction of Deputy Director for Research Eugene G. Fubini and placed them under Deputy Director for Weapon Systems Marvin Stern. It also placed the office of assistant director for ranges and space ground support, which had been separate, under Dr. Stern, and moved the assistant directorships for communications and for special projects (intelligence) under Dr. Fubini.

The order also abolishes the Office of Guided Missiles, making its former chief, Edwin F. Sweetser, special assistant for guided missiles in the office of the assistant director for limited warfare.

A number of interpretations are being put on the latest changes. Some observers believe they are interim steps in a long-term plan to organize Dr. Brown's office into the same broad functional categories being created for handling of the budget and other matters, with the two principal areas being central war forces and general purpose forces. Others believe it is an attempt to force out some of the civilian technical personnel who have remained with the office and its predecessors going back to the time of the office of assistant secretary of defense for research and development. If this interpretation is correct, the forcing undoubtedly is being done for other than budget reasons, since Dr. Brown's office employs fewer than 100 professionals, not counting WSEG and ARPA.

An even more decisive factor, according to qualified observers, is Dr. Fubini's lack of interest in the aeronautics and ordnance fields and his preference for electronics. He was vice president of research and systems engineering for Airborne Instruments Laboratory Division of Cutler-Hammer, Inc., until he joined the defense research office last March.

Critics of the changes are most concerned that two of the most important research fields should be placed among weapon systems, where they are almost certain to suffer in the struggle for funds.

These observers believe all fields of supporting research need a strong champion, particularly in defense work, because the more immediate pressures of development always tend to draw attention, money and technical manpower away from research.

Since Dr. Brown's office is gaining increasing control over all the services' research efforts, the effects of changes in his organization are widely felt.

First group to feel the impact of the changes probably will be the Joint Staff of the Joint Chiefs of Staff, which has been organizing a research and engineering group of its own, carefully modeling it on Dr. Brown's office to simplify the day-to-day relationships between counterpart offices.

In moves unrelated to the shifts of research offices, the following appointments within Dr. Brown's office also were made last week:

- **Dr. Clifford C. Furnas,** chancellor of the University of Buffalo and assistant secretary of defense for research and development from December, 1955 to February, 1957, was named chairman of the Defense Science Board through December, 1962 and at-large member of the board through December, 1964. Dr. Frederick Seitz, chief of the University of Illinois physics department, became vice chairman of the board.
- **Fred A. Payne, Jr.,** manager of advanced systems planning for North American Aviation, was named assistant director of defense research and engineering for strategic weapons.

Unmanned Lunar Program to Be Accelerated

Pasadena, Calif.—National Aeronautics and Space Administration's unmanned lunar exploration program will be accelerated in support of President Kennedy's stepped-up man-on-the-moon program, a top NASA official said here last week at an international symposium on space age astronomy.

Abraham Hyatt, director, program planning and evaluation for NASA in Washington, said both the hard-landed Ranger and soft-landed Surveyor programs will be accelerated. The Surveyor program, he told Aviation Week, will have additional vehicles added to the seven presently projected for the program which aims at soft-landing seven instrument-loaded vehicles on the moon between 1963-1966.

While there had been considerable industry speculation that these and other changes would be made in the unmanned lunar exploration program, and Jet Propulsion Laboratory officials previously conceded discussions about possible alterations in the program were being held, this was first public acknowledgement that changes will be made.

Hyatt also indicated that the lunar orbiter (AW Oct. 17, p. 27, Mar. 6, p. 32), sometimes referred to as the Surveyor orbiter, which would map the front and back sides of the moon sometime during the Surveyor series, will be funded. Previously, the status of the orbiter was shrouded in doubt as funds were not made available for it in the current fiscal budget. Hyatt said the money would not be needed before the expiration of the current fiscal period.

Meanwhile, officials here at NASA's Jet Propulsion Laboratory which is managing the unmanned lunar program said that as far as they knew no changes have yet been made in either the Ranger or Surveyor program. The Surveyor timetable is unchanged, they indicated.

They said the possibilities of increasing the scope of the Surveyor program were investigated but original plans remain unchanged.

Similarly, officials at Aeronutronic Division of Ford Motor Co. and Hughes Aircraft, industry contractors for the Ranger capsule and Surveyor vehicles respectively, said they had not received word of any changes in either program.

Navy Urges National Air Research Goals

Washington—Kennedy Administration should establish national goals for aeronautical research to give this effort the urgency and coordination now exhibited in the space program, James H. Wakelin, assistant Navy secretary for research and development, has told Congress.

He told the House Science and Astronautics Committee in hearings which concluded last week that "in aeronautics we have not had an outline of a whole regime of goals toward which we would like to converge and to find answers to the science." Stated by the Administration, such goals "would help us enormously," he said.

Wakelin and other Navy officials said aeronautical research has suffered because of concentration on space projects, adding that it is time to put the two programs more nearly in balance. But their pleas were accompanied by congressional cuts in the aeronautical research functions of NASA.

Congress last week cut appropriations for NASA salaries and expenses from the requested $226,686,000 to $206,750,000 for Fiscal 1962. This will affect NASA's aeronautical research program since most of it is done by agency employes rather than through contracts with industry. NASA had hoped to get about $3.6 million more in Fiscal 1962 for aeronautical research than the $31 million spent in Fiscal 1961 (AW Aug. 7, p. 39). Now it is almost certain that the research effort will not be enlarged.

Vice Adm. John T. Hayward, deputy chief of naval operations-development, told the House space committee that "a continuing useful aircraft development program has been exceedingly difficult to support in this space-oriented era. We have been forced to drastically reduce the number of various prototypes desired and have concentrated efforts on a very few types, such as the A2F and the F4H. There exists a real need to include prototype aircraft development in the research and development cycle to a greater extent than before."

Although declaring "it is quite obvious many of our development programs have suffered because the Polaris system was a number one priority," Adm. Hayward said he does not feel Polaris was overemphasized. But he said it is time for NASA, the military services and industry to expand their aeronautical research.

Rep. James G. Fulton (R.-Pa.) said that the Tushino air show indicated that "in a two or three-year period we are going to have an aeronautical gap as well as a claimed space gap." Adm. Hayward said "there was nothing in the Tushino show from a research point of view we haven't done . . . [It] is representative of a continued steady development of manned air weapon systems. It does not represent any major breakthrough or any great advance."

Rep. Joseph E. Karth (D.-Minn.) said money alone would not speed aeronautical research. "The services have to put a heavier arm on the people who are doing the research and development work," Karth said. "It is easy to wallow around in the research and development work for long period of time . . . I just can't see these five, six, seven-year lead time periods that are involved."

In addition to arguing for more general emphasis on aeronautical research, Adm. Hayward discussed these development program factors:

- **Anti-submarine warfare aircraft.** He said the Navy should accelerate research and build prototypes for ASW medium patrol aircraft—land, sea and carrier-based; logistic "carrier-on-board" aircraft; amphibious assault aircraft, and heavy logistic helicopters.
- **Engines.** Adm. Hayward said the Navy is developing the TF-30, "the first U. S. jet engine designed initially as a turbofan for high economy and high thrust," but that "additional development must be accomplished to incorporate afterburning and duct-burning in this basic engine to provide for Air Force missions as well as Navy needs. This joint effort should produce a remarkable, versatile and economical jet engine." He criticized the fact that more is not being done to achieve a jet engine with a 12 or 14 thrust-weight ratio for VTOL aircraft. "Facilities such as NASA's Lewis Laboratory are urgently needed for aircraft engine effort in this area."

He said more effort also is needed to develop ramjets, combination ramjet/turbojets and hypersonic ramjets for high-altitude, high-speed reconnaissance aircraft. "Engine development must lead airframe development by about two years," Adm. Hayward said, "to ensure a successful aircraft." He said before Fiscal 1958, an average $5 million a year was spent on applied engine research, but this amount has been diminishing each year since. Navy is seeking $4.3 million for engine research in Fiscal 1962. Adm. Hayward said "for a balanced engine program," $5 million annually for applied research is "a very reasonable amount."

- **Airframes.** "New problems in fatigue life under repeated loads must be solved for current as well as future jet aircraft," Adm. Hayward said. "Flutter of structural panels resulting from the interaction of structural stiffness, weight and air forces present a critical problem that can be solved only by a systematic major research program involving wind tunnel models."
- **Helicopters.** He said an extension is "urgently needed" in the flight test work on all-weather helicopter operations. He added that "a major problem" in helicopter performance is caused by rotor interference effects that increase drag and reduce lift.

"To achieve higher speed," Adm. Hayward said, "investigations must be made of the rotor-hub-pylon-fuselage interference complex. To be able to design confidently future helicopters, the engineer must have reliable aerodynamic test data on lifting rotors at various forward speeds and fundamental information on loads the advanced helicopter will be subjected to."

Aerospace Nova Study

Washington—Requirements of the solid propellant configuration of the Nova booster are to be defined by Aerospace Corp. under a $900,000 letter contract awarded by the National Aeronautics and Space Administration.

Contract is one of the initial results of the joint NASA-Defense Dept. Large Launch Vehicle Planning Group (AW July 31, p. 33) acceleration of the large solids program. Dr. Nicholas E. Golovin, technical assistant to the NASA associate administrator, is the group director. Ranking Defense Dept. representative and group deputy director is Dr. Lawrence L. Kavanau, special assistant for space to the Director of Defense Research and Engineering.

Radiation Test Models

Albuquerque—Air Force Special Weapons Center will use three life-size plastic human models for biological studies in space radiation. USAF researchers want to fly the models eventually in satellites, but initially they will conduct general physiological tests, including accelerations of 10-25g and temperatures of 40-140F, to determine whether the models can stand space flight stresses and to calibrate instruments.

The models are made of an adiprene-base plastic, which has an atomic composition similar to human tissue, covering a skeletal frame. They are 5 ft., 9 in. tall and weigh 162 lb., the anthropometric mean of Air Force flying personnel. They have dosimeters in each arm and leg and in the skull, chest and abdominal areas. The models will be delivered by Alderson Research Laboratories, Inc. under a $35,000 contract.

Defense Department Appropriations—FY 1961-62

(Billions)

Category	Fiscal 1961 Appropriation	Fiscal 1962 Eisenhower Requests	Kennedy March Revisions	House Action	Kennedy July Revisions	Senate Action	Fiscal 1962 Appropriations
Military Personnel	$11.87	$12.27	$11.99	$12.05	$12.75	$12.85	$12.81
Operation, Maintenance	10.72	10.84	11.05	10.94	11.79	11.77	11.73
Procurement	13.52	13.38	15.11	14.88	16.86	16.73	16.67
Research, Development	4.19	4.35	4.79	4.84	4.79	5.29	5.24
Civil Defense	....	....	....	....	.207	.207	.207
Total	$40.30	$40.84	$42.94	$42.71	$46.397	$46.847	$46.657
Distribution							
Army	$9.65	$10.17	$10.32	$10.36	$11.76	$11.87	$11.80
Navy	12.21	12.04	13.57	13.46	14.62	14.53	14.50
Air Force	17.23	17.32	17.72	17.58	18.48	18.93	18.84
Defense Secretary	1.21	1.31	1.33	1.31	1.33	1.31	1.31
Civil Defense	....	....	....	....	.207	.207	.207

Note: In cases where President Kennedy's requests exceeded the amounts appropriated, Congress authorized the Defense Department to make up the difference by transferring money from funds already on hand.

$46.6-Billion Defense Budget Approved

By George C. Wilson

Washington—Congress completed action last week on the Fiscal 1962 defense budget by appropriating $46.6 billion, a record peacetime total which included almost everything President Kennedy requested in his Berlin message as well as extra money for current long-range bombers and the B-70.

The only major cut was approximately $350 million in procurement funds resulting from House insistence that a 2% across-the-board reduction is needed to improve Pentagon buying practices.

The budget bill that went to the White House represents a significant shift away from the long-standing policy of relying primarily on U. S. nuclear weapons rather than conventional forces (AW Aug 7, p. 28). Leaders in Congress see a "balanced program" of nuclear and conventional strength in the bill.

Although the defense measure received the overwhelming approval of both the House and Senate, last minute fights broke out over how much money to appropriate for long-range bombers and civil defense.

President Kennedy, in his March review of former President Eisenhower's defense budget, requested no money for continuing production of the B-52 and B-58 and recommended that the $358 million President Eisenhower asked for B-70 development be reduced to $220 million.

The House voted to appropriate $448.8 million for long-range bombers with the expressed hope the Defense Department would spend most of the extra money to accelerate the B-70 program. The Senate appropriations committee voted to earmark the $448.8 million for the B-70 alone and to appropriate another $525 million for the B-52 or B-58, leaving it to the Defense Department to choose the airplane.

The bill went to the Senate floor Aug. 3, and Sen. William Proxmire (D.-Wis.) moved to strike the $525 million from the budget on the grounds that Defense Secretary Robert S. McNamara did not want the bomber money now and could ask for it later without interrupting production. Sen. Proxmire's amendment failed on a 4-87 vote, with only Sens. Prescott Bush (R.-Conn.), Thruston Morton (R.-Ky.) and Allen J. Ellender (D.-La.) supporting it.

The bomber controversy broke out again in the House-Senate conference last week on the defense bill. The conferees voted to earmark $400 million for B-70 development and to subject the $525 million to the 2% procurement cut originally voted by the House, resulting in a final appropriation of $514.5 million for the B-52 or B-58. There is still no indication the Kennedy Administration will spend the bomber money.

The House had passed its defense bill before President Kennedy requested $207.6 million for civil defense. The Senate voted for the full amount, but the House conferees refused to go along and took the issue to the House floor where the $207.6 million was voted.

Another issue concerned how much to appropriate for utility transports. The House denied the Air Force request for $19.1 million to buy 10 Lockheed C-140 JetStars after the House appropriations committee said it wa "ridiculous" for the Air Force and Nav to make separate studies of aircraft fo the same purpose.

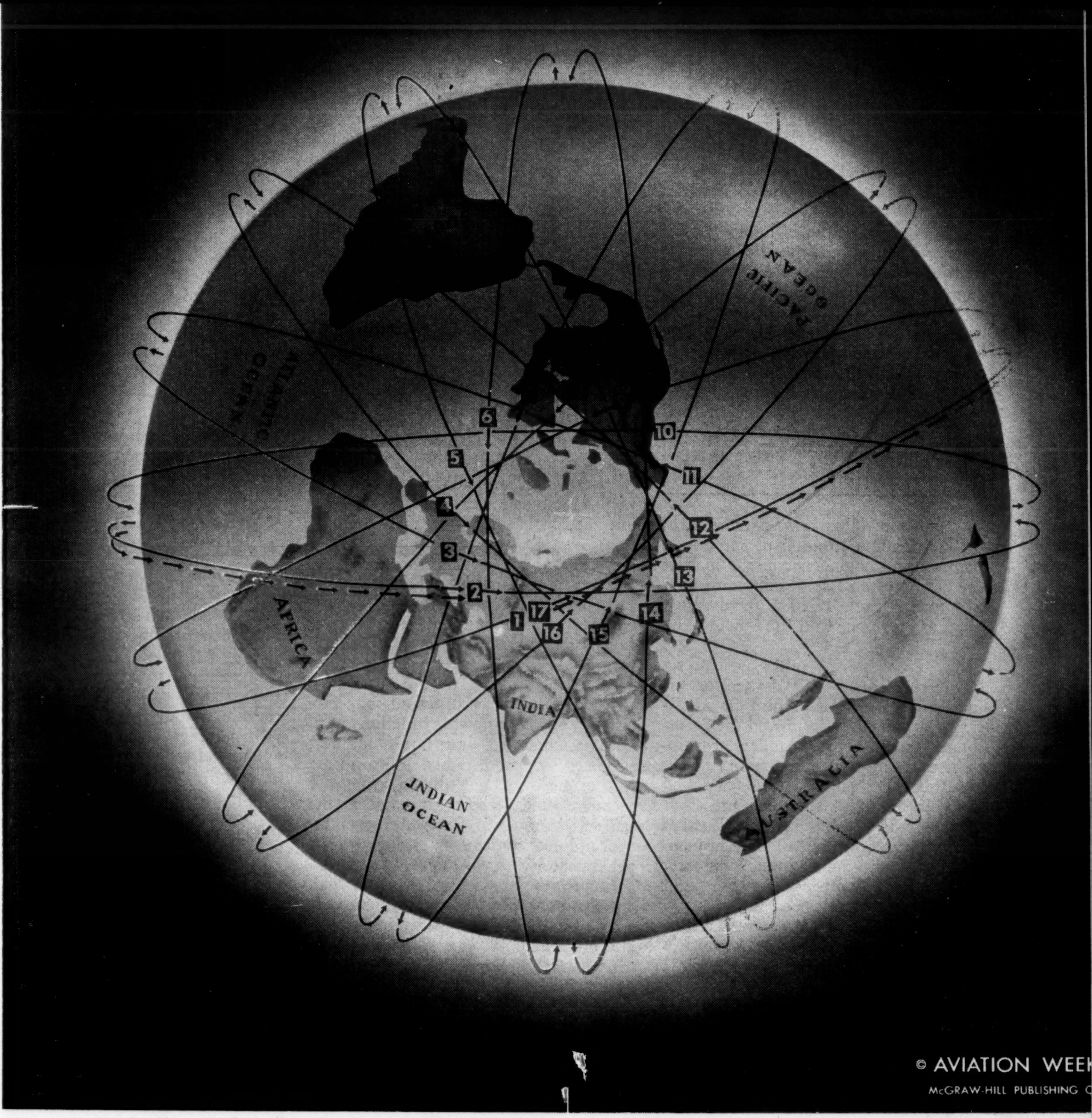
The Senate restored the $19.1 mi lion after Air Force and Navy official promised to work out joint requirement for the aircraft. The conferees vote to appropriate $10 million for utilit transports, giving the Defense Depar ment authority to choose the type. Th Navy has been considering the Fai child F-27 and Grumman Gulfstrea for its utility transport.

For the Air Force Dyna-Soar pro gram, the final bill earmarks $185.8 mil lion from Air Force's $2.4 billion re search and development fund. The Ken nedy budget called for $100 million.

The conferees debated language re garding advertising by defense contrac tors before adopting the recommendations of the Defense Department. The House had passed a blanket prohibition while the Senate bill said a contracto could charge the government for adver tisements to recruit personnel, procur scarce items, dispose of scrap and sur plus materials, procure subcontractors and prepare exhibits. The Senate version prevailed after the conferees eliminated the exceptions for procurement of sub contractors and preparation of exhibits.

The Senate bill authorized the De fense Department to transfer up to 3% of the money in one account to another without prior approval of Congress. The compromise provides for a transfer fund of $200 million rather than the per centage authority.

The other major provisions of the defense appropriation bill remained as they were passed by the Senate.



VOSTOK II orbital path is traced in polar projection map. Vostok I and II were launched from Baikonur (1) and landed at Saratov area (2).

Vostok Scores Bioastronautics Triumph

Washington—Soviet Russia scored another major achievement in bioastronautics last week by successfully exposing its second cosmonaut to more than 25 hr. of weightlessness in a flight of 17½ orbits around the earth. The flight was almost identical to the first recovery of animals and plants from orbit after a day's flight in Sputnik V last Aug. 19.

Soviet Air Force Maj. Gherman Stepanovich Titov—who was backup pilot for Maj. Yuri Gagarin's orbital flight last April (AW Apr. 17, p. 26)—ate three meals, slept about 7½ hr. at one stretch, exercised, worked and controlled the Vostok II between the time it was launched at 9 a.m. Moscow time on Aug. 6 and the time it landed 25 hr. 18 min. later, Russian sources said.

Major purposes of the flight clearly were what Russia claimed they were in its initial announcement 40 min. after launching—a study of the effects on a human of prolonged orbital flight and re-entry and the effects of weightlessness on his ability to work.

But the Soviets stressed a different factor—controllability of the spacecraft—in most of the statements that followed the 26-yr.-old major's successful landing. Russia has shown extreme sensitivity to the U. S. claim that although Maj. Gagarin was the first human to fly in space, U. S. Navy Cdr. Alan Shepard became the first to control a spacecraft on his suborbital Mercury flight May 5.

"Again Soviet science and technology scored a first—the first controllable spaceship," Prof. Boris Klosovskiy, corresponding member of the Soviet Academy of Medical Sciences, told the Rus-

100-Megaton Bomb

Washington—Russian scientists have proposed building a 100-megaton yield bomb and Russian rocketeers have said such a bomb could be launched, Soviet Premier Nikita Khrushchev said last week.

Khrushchev said he had told U. S. disarmament adviser John McCloy and Italian Premier Amintore Fanfani this proposal exemplifies how there is no end to the arms race. He said his government will do all in its power to prevent war, "but if war is unleashed we are ready to muster all our means and resources against the aggressor."

Khrushchev said his reply when the 100-megaton bomb was proposed was: "Fools, what are you doing? Is this your version of the future?"

sian state-controlled news agency Tass.

"The genuine triumph of the Soviet scientists and engineers consists in that they have created a spaceship controlled by a man," Prof. Nikolai Barabashov, Soviet astronomer, told the Soviet news agency.

Maj. Titov himself told a welcoming crowd in Moscow two days after his flight ended that his landing at an exact, prearranged spot proved that cosmonauts now could "land spaceship-satellites at any place on earth."

Vostok II apparently was launched and recovered from the same sites that Vostok I was. Maj. Titov told Russian newsmen after he landed that he controlled his craft for an hour soon after launching and controlled it again eight hours later.

"My spaceship was a very smart machine and it was very easy to guide," he said. "I could turn it any way I wished, I could steer it in any direction needed and I could land it wherever I wanted. When I took over manual control of the ship, I felt like a real pilot."

Khrushchev's Humor

Soviet Premier Nikita Khrushchev, who elevated Maj. Titov from candidate to full member of the Communist Party for his feat, used the flight to continue belittling U. S. space efforts and to introduce another military angle besides controllability of spacecraft—possible orbiting of nuclear weapons.

"The Americans do not launch," Khrushchev said at a banquet at the Kremlin. "Their men only jump upward and fall into the ocean. Anyway, we are glad that they did not drown."

The premier told the Moscow welcoming rally that the flight reflected the might of Soviet science and industry and his country's desire for peace and friendship.

"Vostok II did not carry atom bombs or other armaments for killing—but peaceful instruments," Khrushchev said. He said Russia has the strength to "crush the aggressors" if its enemies unleash a new war. The flight also provided a backdrop for Khrushchev's speech Aug. 7 in reply to President Kennedy's recent speech expressing U. S. determination to maintain a free West Berlin.

Vostok II weighed 10,408 lb., almost the same as all the inhabited Soviet satellites launched since May, 1960. Its orbit was inclined 64 deg. 56 min. to the equator. Orbital period was 88.6 min. Perigee was 110.36 mi. and apogee was variously reported as 159.34 mi. and 157.48 mi. Transmitters used 15.765 and 20.006 mc., and a beacon operated on 19.995 mc. A frequency modulated transmitter with a frequency deviation of ±30 kc. operated on 143.625 mc.

Observed From Earth

The capsule carried biological samples, had three portholes and unspecified optical instruments for observations, and appeared as a star of first magnitude brightness to observers on earth.

Maj. Titov was observed by television, and physiological functions were both telemetered and taped for fast playback to earth when the capsule was over Soviet territory. During the second orbit, Soviet announcements said, his pulse was 88 beats per minute and his respiration rate 15 to 18 per minute.

On the night of Aug. 6, while Maj. Titov was asleep, his pulse rate was a "normal" 58 beats per minute. An announcement on the 11th orbit gave his rate as the same 58 beats, apparently while he was awake. Other announcements based on telemetry readings during the flight gave pulse rate as 80-100 per minute and respiration as 20-28 per minute, and said "the electrocardiograms do not to any extent differ from the initial ones recorded on the ground."

Cabin temperature ranged between 20-22C, pressure was 1.05 atmospheres, relative humidity ranged from 70 to 75%, oxygen content was 24.33% and carbon dioxide 0.4%.

Maj. Titov ate a three-course lunch, a supper and "a solid lunch" the next day, the reports said. He saw the moon twice and told Russian newsmen it looked just as it does from earth. He moved from light to shadow to light about 17 times as he circled the earth.

As the cosmonaut crossed countries and continents, he broadcast greetings to their people. He said his ship "had excellent stability and was very sensitive." He slept well without dreaming, needed only an hour and a half of sleep after landing and found that everything is done smoothly in space—there are no sharp movements. But he found that he became homesick during the flight.

"There is nothing more splendid in the world than mother earth," he said. "On earth one can stand, work and breathe. I knew there was something in the nature of homesickness called nostalgia, but I found there is also a homesickness for the earth."

Maj. Titov said he noted that some radio broadcasts he listened to on the Sunday that he flew were "talking about saints. It's too bad I didn't have the proper transmitter—I would have told them what is going on in the heavens."

The Major, who was a captain before his flight, entered preliminary flight training in 1953 and studied at the Stalingrad flying school from 1955 to 1957.

Maj. Titov is a year younger than Cosmonaut Gagarin, who was promoted from senior lieutenant to major on the morning of his flight by Minister of Defense Marshal Malinovskiy.

Next step in Soviet space flight, according to Prof. G. I. Pokrovskiy, is "to study the possibilities of prolonged life and creative work of man in space." He said Maj. Titov's flight is part of a systematic study, and said the flight will put an end to "the protracted discussion of whether the presence of man is essential in a spaceship.

"There is only one answer now," Pokrovskiy said. "A man must be in the cabin of a spaceship, for he can not only observe and be himself the object of the scientists' observations, but can actively control the flight of the spaceship."

U.S.-Soviet Bilateral

Washington—U. S. and Russia reached basic agreement last week on a bilateral air transport pact providing for reciprocal service between New York and Moscow, and a formal agreement probably will be signed this week.

Late last week, only a few technical details, none of which threatened to bar a final agreement, remained to be settled. Formal pact will be signed by the U. S. and Soviet governments. A second agreement, covering matters pertaining to traffic and tariffs, will be signed by Pan American World Airways, U. S. carrier authorized to operate the service, and Aeroflot, the state-owned Russian airline.

Service on the route probably will begin next spring. However, one possible threat to Russian operation of the route remains. The Scandinavian countries are refusing Aeroflot transit rights or rights to fly beyond Copenhagen.

Satellite Competition Potential Disputed

By Katherine Johnsen

Washington—All aerospace manufacturers of all countries—including the Soviet Union—will be on an equal basis to compete for hardware and operational contracts for a communications satellite system under President Kennedy's blueprint for a single global system, James E. Dingman, vice president and chief engineer of American Telephone and Telegraph Co., told the Senate Small Business Subcommittee on Monopoly.

Ten U. S. international communications common carriers are now meeting to recommend an organization implementing the President's plan for private ownership and operation of the U. S. segment of the global system (AW July 31, p. 25). Federal Communications Commission has set an Oct. 31 deadline for submission of their recommendation.

Sen. Russell Long (D.-La.), chairman of the subcommittee, expressed apprehension throughout the hearings that AT&T and other major common carriers owning the satellite system—International Telephone and Telegraph Co. and Radio Corp. of America—would favor their own manufacturing subsidiaries in procurement.

Dingman insisted that this would be impossible under the policies of bona fide competition stated by FCC and Justice Department, and he added:

"We want the best brains of the world—not just the U. S.—to contribute to the system. Foreign countries are going to have a lot to say on the technical specifications and procurement—and it is going to be on the basis of the best we can get."

Congressional Criticism

In a speech on the House floor, Rep. James Roosevelt (D.-Calif.) said that if AT&T—"whose assets of $23 billion are greater than those of Standard Oil of New Jersey, General Motors, and United States Steel combined"—is given a prime position in the satellite system "it can be expected to do as it has done in the past—namely, purchase virtually every piece of equipment from its wholly owned supplier, Western Electric, and conduct its research in the Bell Laboratories. . . ." Rep. William Fitts Ryan (D.-N.Y.) introduced legislation requiring government ownership of the communications satellite system for at least two years.

Dingman reported that if ownership is allocated among the 10 carriers on the basis of present services, AT&T will own 80% of a U. S. system and somewhat less than 50% of a global system.

IT&T and RCA—the other two major participants on the ownership committee established by FCC—are preponderantly manufacturing concerns and have been active in space satellite communications research and development. Of IT&T's $800-million total annual gross income, only about $40 million—or 5%—is from common carrier activities, according to Dr. Henri Busignies, IT&T vice president and general technical director.

He pointed out that IT&T has already built an experimental station for moon relay and other satellite relay tests at its laboratories at Nutley, N. J., and plans to build a similar station in South America for the Relay satellite project which can later be expanded to serve as a world communication terminal. IT&T also has completed the initial hardware design for a repeater type communications satellite.

Dr. Elmer W. Engstrom, senior executive vice president of RCA, reported that only $32 million of RCA's $1.5-billion annual income is from common carrier activities. RCA provided equipment for Project Score, the first satellite relay of voice transmission, developed the Tiros television weather satellites, and is the prime contractor on Project Relay, which will be the first experimental active multi-channel communications satellite.

Courtlandt S. Gross, president of Lockheed Aircraft Corp., told the subcommittee that "it is extremely difficult to envision free competition in the hardware market for the system where the owners of the system are themselves both operators and manufacturers.

"We are not primarily interested in an ownership share. . . . We are interested . . . in providing satellite-system planning, design, engineering, and operational services. . . ."

Gross stressed the need for speed in moving forward with the space communications program. If the international carriers do not compose their differences and come forth with concrete proposals "in the very near future," he declared, "then the other private interests who have indicated a willingness and readiness to undertake the establishment of the system should be given the opportunity to do so."

From the propaganda and prestige

NASA, CAB, FAA Fiscal 1962 Budgets

Congress last week completed action on the Fiscal 1962 independent offices appropriation bill. Civil Aeronautics Board's request was reduced $3.6 million; Federal Aviation Agency's by $19.5 million; and National Aeronautics and Space Administration's by $112.5 million.

Congress also placed a ceiling of $6 million on subsidy payments to helicopter airlines and stated that the total cost of a two-year program of studies on a civil supersonic transport "should be held down to not more than $20 million." This is $30 million below FAA's estimate of $50 million. CAB asked $6.9 million for helicopter payments.

	Requested	Approved by Congress	Difference
National Aeronautics and Space Administration			
Salaries and expenses	226,686,000	206,750,000	–19,936,000
Research and development	1,295,539,000	1,220,000,000	–75,539,000
Construction of facilities	262,075,000	245,000,000.	–17,075,000
Total	1,784,300,000	1,671,750,000	–112,550,000
Civil Aeronautics Board			
Salaries and expenses	9,050,000	8,900,000	– 150,000
Air carrier payments	81,700,000	78,250,000	– 3,450,000
Total	90,750,000	87,150,000	– 3,600,000
Federal Aviation Agency			
Operations	441,000,000	434,300,000	– 6,700,000
Facilities and equipment	126,000,000	120,000,000	– 6,000,000
Airport aid	70,000,000	70,000,000	.....
Research and development	65,000,000	60,000,000	– 5,000,000
Operations, national capital airports	6,000,000	5,200,000	– 800,000
Construction, National airport	4,200,000	4,200,000	.....
Construction, Dulles International Airport	20,100,000	20,100,000	.....
Civil supersonic aircraft development	12,000,000	11,000,000	– 1,000,000
Total	744,300,000	724,800,000	–19,500,000

viewpoint, United States Information Agency urged "the fastest possible" global system—whether it is owned and operated "by one, two, or numerous companies."

The controversy in the common carrier industry over the merits of a low random orbit system versus a high-altitude synchronous orbit system was highlighted at the Long subcommittee hearings.

AT&T favors an initial system of 25 to 30 satellites in orbit at an altitude of about 7,000 mi. This would give U. S.-Europe coverage, and at times, links with other points. According to AT&T, such a system could be operational within three to four years. AT&T's main objection to the Advent concept of three satellites in synchronous orbit at a 22,300-mi. altitude is that time lag and echo in voice transmission makes conversation awkward. AT&T wants the synchronous orbit approach developed for possible introduction in the operational system at a later date as traffic develops.

IT&T, RCA, and General Telephone & Electronics Corp.—which is still fighting vigorously but unsuccessfully for membership on the ownership committee appointed by FCC—favor the Advent concept. They pointed out that the random orbit system would not meet the President's requirement for global coverage, while one Advent type satellite would cover 91% of the globe, and three would give complete global coverage around-the-clock.

Dr. Herbert Trotter, president of General Telephone & Electronics Laboratories, a fully-owned subsidiary of GT&E, reported that his firm has developed an echo suppressor that solves the echo-time delay problem. The company has an Army Signal Corps contract to manufacture the suppressor for use on Advent. GT&E's subsidiary, Sylvania Electric Products, is building the ground antenna system for Advent.

IT&T's Busignies favored one Advent type satellite with a few hundred channels at the outset, doubling present capacity, later a three satellite system with 1,000 channels, and ultimately a television channel. He estimated that the first satellites would have a lifetime of "a few weeks," but anticipated that it would be possible eventually to extend this to a 20-year life span.

GT&E's Trotter challenged the contention of proponents of the random system that it can be accomplished earlier. Commenting that the minimum random system would involve 48 satellites "all of which must be manufactured, tested and launched with appropriate provisions for failures," he added:

"Schedules prepared by experts in space technology indicate that the launching time advantage for a stationary satellite system by reason of the lesser number of satellites would permit a minimum of 11 more months' research and development time on the stationary orbit satellite than on the random orbit satellite with the same in-service date for either system."

House Committee on Science and Astronautics has reported that although there has been "a significant lack of official comment by Soviet officials," U. S. scientists who have talked with Russian space experts state that they are keenly interested in space communications and are concentrating on the synchronous Advent type satellite.

"A random orbit system could discredit us before the world as a leader in space communications if Russia establishes a stationary satellite system," Trotter told the Long subcommittee. "If the U. S. went ahead with a low random orbit system it would be possible for Russia to hold back until we were deeply committed to this system and had launched perhaps two-thirds of the satellites and then with three satellites the Russians could establish a truly worldwide system before our limited system was even in operation."

A "limited" random system in which 10 points were given the ability to communicate directly with each other would require 400 satellites in orbit, Trotter said.

McNamara Preparing 5-Year Plan For Strategic Weapon Procurement

Washington — Defense Secretary Robert S. McNamara told the Senate Subcommittee on National Policy Machinery last week that he will submit to the President "very soon" a five-year program for procurement of strategic weapons—weapons for "central war offensive forces."

The final proposals of Air Force, Navy and Army were presented to McNamara and Defense Deputy Secretary Roswell Gilpatric at a 2½-hr. session on Aug. 4.

Separately prepared proposals by Air Force and Navy were submitted to McNamara July 3. AVIATION WEEK reported (July 24, p. 34) that these proposals included recommendations for a total 3,910 intercontinental ballistic missiles ready for firing by 1967; 2,500 fixed Minuteman, 415 mobile Minuteman, 275 Titan, and 720 Polaris missiles.

The program proposed by USAF was subsequently studied by Navy, and vice versa, and both programs were studied by Army.

The final presentation by USAF and Navy included an evaluation of the proposed program of the other service, and an evaluation of both programs by the Army, McNamara said. The presentations were made by the secretary and chief of staff of each service.

In making his recommendation to the President, McNamara told the subcommittee he would point out alternatives and note the objections to it by individual services.

In addition to ICBMs, the 5-yr. procurement program for central war offensive forces will include strategic bombers, tankers, air-to-ground missiles, and intermediate-range missiles.

Subcommittee, headed by Sen. Henry Jackson (D.-Wash.), also heard McNamara testify that:

- **Standardization of space launch** vehicles is a "must." He said there should be one vehicle, or one combination of vehicles, for each payload category for use by either Defense or NASA.
- **Role and importance** of the Joint Staff of the Joint Chiefs of Staff will steadily increase during his administration, McNamara reported. "The Joint Staff, being composed of experienced officers from all military services, has the potential of becoming a most valuable asset to the Department of Defense as a whole," he commented.
- **Recently-established Defense** Intelligence Agency (AW July 17, p. 39), will achieve "unity of effort" and "a more efficient allocation of intelligence resources, more effective management. . . and elimination of duplicating intelligence facilities, organization, and tasks," he said.
- **The functional budget** is a "substitute" for a reorganization of the military establishment along functional lines—and not a first step in this direction. In previous testimony to the subcommittee, W. J. McNeil, former assistant secretary of defense-comptroller, said that defense reorganization would inevitably follow the new budget pattern —involving central war offensive forces, central war defensive forces, general purpose forces, sealift-airlift forces, etc. McNamara said the budget structure will have "no influence whatever on the organization structure," that by perfecting procurement according to requirements it will lessen demands for a reorganization, and "in a very real sense is a substitute for it."
- **Establishment of one Defense** agency on disposal of obsolete and surplus property is under active consideration. McNamara noted that an average of less than five cents on the dollar is now being realized on surplus sales.

Further 990 Write-offs Foreseen

Drag problems largely involving the engine nacelle thrust reverser area are proving to be an obstacle to the Convair 990 turbofan-powered transport meeting its maximum speed guarantees and will cause further write-offs on top of the $116,500,000 for the first half of 1961.

A program is under way to reduce the base drag of the nacelle area, which is built by General Electric to a Convair design. The problem was not detected until a fully instrumented aircraft began intensive flight tests a few weeks ago.

Modifications to the outboard nacelle pylons because of a pod oscillation problem (AW May 22, p. 39), which figured heavily in the first-half write-off, are not involved in the drag problem. Some study is being given to the effect of the addition of leading edge high lift devices, but no conclusions have yet been reached.

As a result of the $116.5-million charge which amounted to $55,920,000 after taxes, General Dynamics Corp. reported a $32,920,000 deficit for the period. Last year the company reported $12,095,151 in profits for the first half on sales of $979 million. Sales for the 1961 first half totaled $1,010,887,737.

General Dynamics directors established an executive committee at their last meeting headed by Henry Crown, chairman of the corporation's Material Service Division. The committee will concentrate on problems of the jet transport.

Three Firms Added To Apollo Bid Request

Washington – National Aeronautics and Space Administration has added Aerojet-General Corp., Radio Corp. of America and Space Technology Laboratories to the list of companies invited to bid on Apollo and has selected Massachusetts Institute of Technology Instrumentation Laboratory to develop the prototype guidance and navigation system for the manned space vehicle.

NASA will hold a second bidders conference at Space Task Group headquarters, Langley Field, Va., Aug. 14-15 to acquaint the three new companies, who submitted unsolicited requests to bid, with Apollo's background and progress. At the same time, NASA will present to the new bidders and the 12 originally invited to bid (AW Aug. 7, p. 29) more details on the recently-issued specifications for the crew and propulsion modules.

Under an estimated $4-million contract, MIT–which has been working on a design study for the past seven months –will design and build the first several guidance and navigation systems, plus ground support and checkout equipment. Quantity production will be contracted to industry later.

With a laboratory module for extended earth-orbit missions and an additional propulsion module for manned lunar landing missions–both of which would be mounted below the combined mission-command module–the Apollo spacecraft will apparently resemble NASA's own design study (AW June 5, p. 26-27 and July 31, p. 29). The three-man crew will function entirely within the mission-command compartment and will remotely operate all equipment aboard the other modules, including a service module for the maintenance of the terminal propulsion unit and some power systems.

Liquid hydrogen/liquid oxygen engines are specified for the lunar propulsion module, but the type of terminal engines are to be suggested by the bidder. NASA also has specified vernier engines, burning hypergolic fuels, for guidance corrections.

All propulsion systems are to be controlled by the crew within the mission-command module.

Other NASA specifications include:

- **Launch vehicle** reliability of 0.95.
- **Descent rate** of 30 fps. from an altitude of 5,000 ft. down, apparently to be achieved by conventional parachutes.
- **Life support** for the three-man crew for a post-landing period of 72 hr., either on land or in water.

The Apollo control center will be located at the launch site and will use both the Mercury tracking network and whatever other equipment is available at the time of launch–now tentatively scheduled for January, 1967.

News Digest

Italy is claiming a world's altitude record of 49,970 ft. for aircraft with a gross weight less than 6,615 lb. The mark is claimed for an Aeronautica Macchi MB 326 jet trainer, powered by a Bristol-Siddeley ASV.11 turbojet developing 2,460-lb.-thrust. Pilot was Guido Carestiato, who made the flight Aug. 4. Present official record is held by Russian Yak-32 trainer powered by a 1,764-lb.-thrust engine, flown to 46,863 ft. last Feb. 22 by Valentine Moukhinein.

Erik Jonsson, board chairman of Texas Instruments, Inc., and a principal shareholder of Braniff International Airways, has been named to the board of the carrier. Jonsson was a participant in the purchase by four top Texas Instruments executives of Sen. William A. Blakley's controlling interest in the airline (AW May 29, p. 34). Milton McGreevy, Kansas City, Mo., has resigned from Braniff's board.

S-3 energetic particle satellite (AW Apr. 17, p. 34) is scheduled to be launched this week by the National Aeronautics and Space Administration aboard a three-stage Thor Delta launch vehicle. Orbit will be highly eccentric, with a perigee of about 170 mi. and an apogee of about 50,000 mi.

Martin-Marietta Corp. has been chosen as the name of the company which would result from the proposed merger of the Martin Co. and American-Marietta Co. Stockholders of both firms will vote on the proposal Oct. 9. George M. Bunker, Martin chairman, would be president and chief executive officer, and Grover M. Hermann, American-Marietta chairman, would be chairman of Martin-Marietta.

Thomas F. Dixon, former vice president for research and engineering at Rocketdyne Division of North American Aviation, Inc., will replace USAF Maj. Gen. Don R. Ostrander as director of the Office of Launch Vehicle Programs at the National Aeronautics and Space Administration on Sept. 18. Gen. Ostrander will become the vice commander of Air Force Ballistic Systems Division on Sept. 1.

House rules committee last week decided to ask the House commerce committee to conduct a study on reducing aircraft noise, while the Federal Aviation Agency and National Aeronautics and Space Administration announced they jointly had signed a $100,000 noise study contract with Bolt, Beranek and Newman.

First Air Force-General Dynamics/ Astronautics Atlas-F series missile, designed for silo operation, successfully flew 5,000 mi. down the Atlantic Missile Range on Aug. 8. Atlas-F, which will carry a full load of RP-1 fuel at all times and will be loaded with liquid oxygen just prior to launch, is fitted with new valves on the fuel tanks and filtering unit that traps any impurities settling to the tank bottom during storage.

Discoverer XXVIII, launched Aug. 3 from Vandenberg AFB, Calif., apparently failed to achieve polar orbit because of an autopilot malfunction in the satellite control system, despite announced modifications to the Thor booster system and the Agena B control system.

POLSKIE LINIE

LOT POLISH AIRLINES' 84-passenger Il-18 turboprop transport at the Warsaw-Okecie airport. The line operates three of the Soviet-built planes, mainly on the Warsaw-Moscow route. Il-18 service will be extended to Paris, Rome and London this year.

Polish Airline Plans Transatlantic Service

LOT, state-owned airline, drafting expansion plans for 1963-65; jet equipment purchases a priority item.

By Edith Walford

Warsaw—LOT, state-owned Polish Airlines, is drafting plans to become a transatlantic carrier in the 1963-65 period and is shopping for jet equipment to fit its needs in both eastern and western markets.

Best Western prospect at the moment appears to be Great Britain, where industry may receive a Polish order for four advance design jet transports. Details probably will be included in the first draft of a special trade agreement now being negotiated between Britain and Poland.

Another urgent requirement, according to a company official, is a medium-range jet transport seating about 60 passengers. Originally, the Polish carrier, like East German Lufthansa, hoped to introduce its first jet services with several production models Type 152 four-jet transports built by VEB Flugzeugwerke in Dresden. However, along with all other East German aviation projects, production of the 152 was scrapped in the country's economic reorganization and reorientation this year (AW Mar. 27, p. 28), and LOT is now looking elsewhere for a suitable medium-range jet transport. At present, because of political and financial reasons, Russia's new Tu-124 medium-range transport is leading among a number of other contenders for the transport order.

The Polish airline also needs a suitable replacement for its older Il-14s and Li-2s and will soon evaluate on its domestic routes the new Polish 20-passenger MD-12 piston-engine feeder transport developed and built by the Instytut Lotnictwa (Aeronautical Institute) of Warsaw. First prototype of the MD-12 flew in 1959, but the second aircraft is being modified, primarily to reduce the high cabin noise level. Improved cabin insulation and a change in the location of the engine exhaust probably will be included in the modifications.

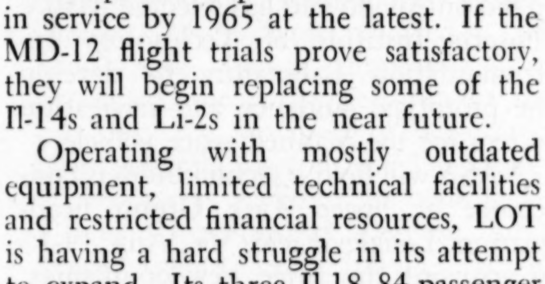
Powerplant of the aircraft consists of four 320-hp. air-cooled Polish-built Narkiewicz engines. Maximum takeoff weight is approximately 16,500 lb., cruise altitude 6,188 ft. and maximum ceiling 13,120 ft. According to LOT engineers, the MD-12 is exceptionally economical in operation, using only about 79.2 U.S. gal. of fuel for all four engines per flight hour.

LOT began its postwar domestic operations practically from scratch on Mar. 6, 1945, when it received 10 Douglas DC-3s together with trained crews as a gift from the Polish air force. Additional aircraft of this type—Soviet-built Li-2s—were subsequently bought from Russia, the last in 1953, and the carrier plans to phase out all 20 still in service by 1965 at the latest. If the MD-12 flight trials prove satisfactory, they will begin replacing some of the Il-14s and Li-2s in the near future.

Operating with mostly outdated equipment, limited technical facilities and restricted financial resources, LOT is having a hard struggle in its attempt to expand. Its three Il-18 84-passenger turboprop transports introduced in April are the only new aircraft in its aging fleet of U.S. Convair 240s and Soviet Il-14s and Li-2s.

Accident-Free Record

Since the crash of an Il-14 at Moscow in 1957 when six passengers were killed and a number of others injured, LOT says it has maintained an accident-free record. "But it is high time we



LOT'S domestic route pattern has proven unprofitable thus far.

FIRST POLISH-DESIGNED TRANSPORT since World War II, is the four-engined, 20-seat MD-12. Short-haul aircraft was built by Polish Aeronautical Institute. The airplane has been undergoing flight tests from 1959.

get the equipment to match our good pilots," one official told Aviation Week.

In order to achieve some degree of operational success as well as for reasons of national prestige, the establishment of a transatlantic network takes top priority in LOT's future plans. Company officials, in predicting success for such an operation, point to the fact that there are about six million emigrants of Polish origin living in the U. S. and Canada who, they say, would like to fly with LOT to visit their native country and relatives who are still residing in Poland.

LOT has entered preliminary talks with British Overseas Airways Corp. on the possibility of establishing transatlantic service. Discussions have been general so far, exploring the possibility of such service in conjunction with BOAC, in which the British airline would operate the flights on behalf of LOT, or by a pooling agreement.

In addition to the three Il-18s, which in April began serving LOT's main international route between Warsaw and Moscow via Vilna on a three-times-a-week round-trip basis and also are used for international charter flights, the airline's present fleet comprises four 40-seat Convair 240s, 12 26-seat Il-14s and 20 24-seat Li-12s.

Direct Service

By this fall, LOT plans to put the Il-18s on its direct Warsaw-Zurich round-trip route now being served on a three-times-a-week basis by Il-14s. International Il-18 route extensions to the Near and Far East from Warsaw via Athens to Damascus and probably to Cairo and Teheran, also are planned for next year. By then, in order to exploit the traffic potential in peak periods, the present 84-passenger Il-18s will have been converted to 111-seat configuration.

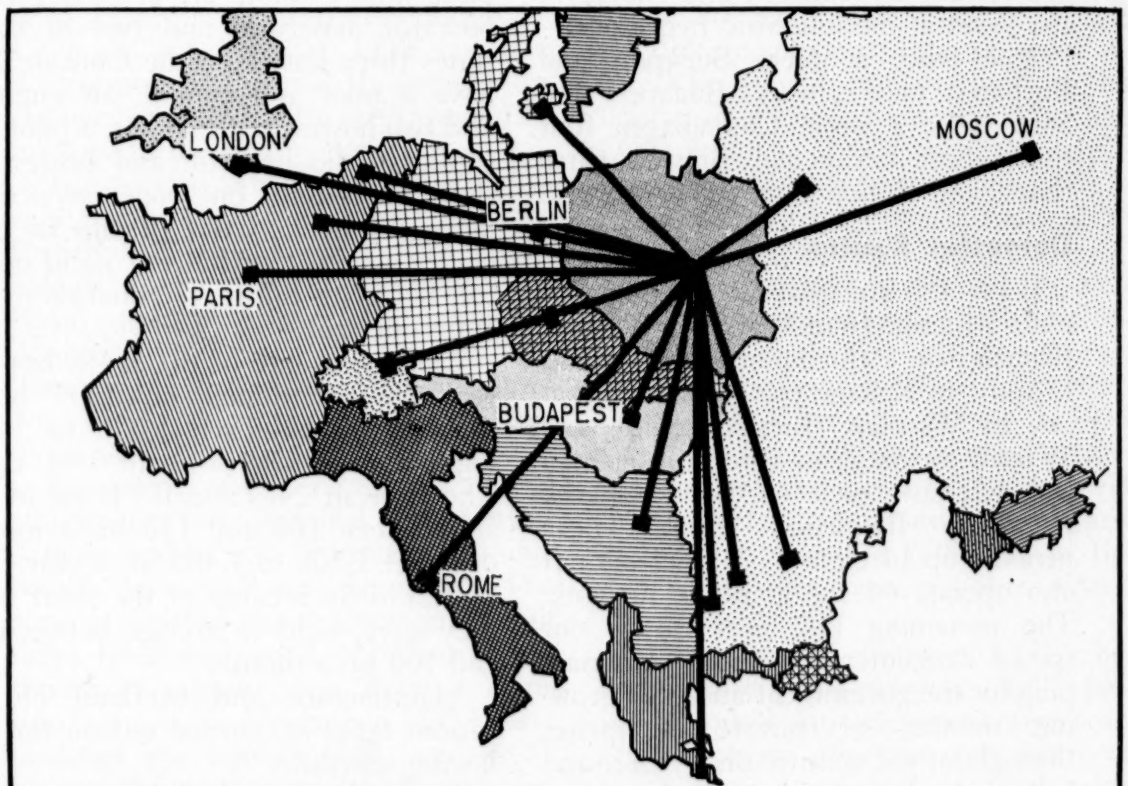
LOT's international network now serves 17 European centers, including Moscow and Vilna in the Soviet Union. A number of these, particularly East European routes, are operated in pool with CSA Czechoslovak Airlines, MALEV (Hungary), TABSO (Bulgaria), East German Lufthansa and TAROM (Rumania).

Domestic Routes

The Polish carrier has only six domestic routes, none of which is economical according to LOT because of their close proximity to one another. Consequently, it is not planned to establish any additional domestic routes or airports for the time being. With the exception of the one international airport at Warsaw-Okecie, which has three concrete runways—the longest 6,560 ft.—only Gdansk out of the six commercial airports in Poland has two concrete runways. Kracow and Poznan have one concrete runway each. The remaining—Wroclaw, Szczecin and Rzeszow—have grass strips only.

A contributing factor to the loss of revenue on the airline's domestic network is the low fares charged within Poland, the lowest of any in Europe, said one LOT official. One example quoted is $7.20 per passenger for the approximately 186-mi. flight from Warsaw to Poznan or Warsaw to Kracow.

Convair 240s currently serve most of



INTERNATIONAL ROUTES center on Warsaw and link most major European capitals. East Berlin and Budapest serve as secondary terminal points.

START
11
WARSZAWA
POLSKIE LINIE LOTNICZE

LOT IL-14 AIRLINER deplanes passengers at the airline's home field, Warsaw-Okecie. The carrier operates 12 of these craft.

LOT's longer international routes with the exception of the Warsaw-Moscow Il-18 flight. The Convairs operate from Warsaw via East Berlin to Amsterdam and via East Berlin to London, each on a three-times-a-week round-trip basis. Other round-trip services include Warsaw to Paris via East Berlin, four times weekly; Warsaw, Vienna, Rome, twice a week; Warsaw, Budapest, Belgrade, Athens, twice a week.

The Il-14s, some of which are soon to be converted from their present 26-passenger to 28-seat configuration, serve LOT's East European network as well as Brussels, Copenhagen and Zurich in the West at the following frequencies—Prague twice a week; Budapest and Bucharest once a week; Budapest and Sofia twice a week; Copenhagen four times; East Berlin and Brussels three times, and Zurich three times a week.

Domestic Routes

Il-14s also are used on the domestic route structure from Warsaw to Gdansk (Danzig) on a three-times-a-week basis; Warsaw to Kracow twice a week; Warsaw to Wroclaw (Breslau) twice, and Warsaw to Szczecin (Stettin), Poznan and Rzeszow each on a once-a-week round-trip frequency. During peak periods, up to eight Li-2 relief aircraft also operate on the domestic network. The remaining Li-2 fleet carries out special assignments including air mapping for the government and for a growing number of private enterprises throughout the country on a year-round basis.

The carrier, however, does not follow the usual practice of most state-owned East European airlines such as Russia's Aeroflot and CSA Czechoslovak Airlines, which, in addition to normal passenger transport operations undertake air ambulance, crop dusting or skywriting duties. Air rescue missions are conducted by the Red Cross under the auspices of the Polish Ministry of Health, and the Polish aero clubs are responsible for business connected with agriculture or skywriting activities.

Crew Makeup

The LOT Il-18 crew consists of a pilot and copilot, an engineer, radio operator, navigator and two or sometimes three hostesses; the Convair 240s have a pilot and copilot, an engineer and two hostesses; the Il-14s, a pilot and copilot, radio operator and hostess on short hauls and, on longer services, a flight engineer. Crew of the Li-2 includes a pilot, copilot and radio operator, but plans call for elimination of the radio operator.

Utilization rate of the Il-18s has not yet been determined, but LOT hopes that it will approach 1,000 to 1,200 flight hours yearly or about 3 hr. daily. The Convair 240s and Il-14s are in the air between 100 and 130 hr. a month or about 1,200 to 1,400 hr. a year. The Li-2s, chiefly because of the short hops they serve, yield on average between 80 and 100 hr. a month.

Maintenance and overhaul of the various types are carried out on the following schedule:

- **Powerplants of the Il-18** are serviced after first 50 and then 100 flight hr., with major engine overhaul after 300 hr.
- **Il-18 airframes** receive first check after 50, second after 100 and major overhaul after 2,000 hr.
- **Convair 240 engines** are serviced on a progressive basis after 50, 100 and 300 flight hours, which keeps them grounded for one, two and three to four days respectively. Major overhaul takes place after every 1,500 flight hours, then the cycle begins again. Major overhauls take on average about 30 days.
- **Convair 240 airframes** receive their first check after the first 50, the second after 100 flight hours, requiring one and two days in each case. This form of progressive overhaul is worked in eight stages, major overhauls taking between 30 and 40 days after every 1,500 hr.
- **Il-14 powerplants** are serviced after 50 and 100 hr. lasting in each case one and two days. LOT has three different models of Il-14 ASh-82T engines so that, according to their age, major overhauls are carried out after every 500, 700 or 1,000 flight hours which takes up to 20 days. Exchange of engines takes six days extra.
- **Il-14 airframes** are serviced after every 50, 100, 500, 1,000 and 2,000 hr., major overhaul after 4,000 hr. Time required for each of these checks is one, two, six, 20 and 40 days respectively. The Il-14s now in service were bought between 1954 and 1956; none of them has logged 4,000 flight hr. thus far.
- **Li-2 engines** are checked after every 50 and 100 hr. lasting one and two days in each case. Major overhaul after every 700 flight hours lasting 20 days.
- **Li-2 airframes** are serviced after 50,

100, 200 and 600 hr., major overhaul after every 1,800 hr. requiring one, two, three, to six to seven days and 2½ to 3 months respectively.

LOT's total staff including pilots and air hostesses numbers about 1,500 at the moment. Many of the airline's 62 pilots and mechanics and other skilled personnel served with the Polish air force and/or RAF during World War II. For example, 60-year-old Stanislaw Plonczynski, head of the Polish carrier's pilot training center at Warsaw-Okecie Airport, performed distinguished service as a ferry pilot between England and Canada during World War II. Earlier, he had logged more than 1.25 million mi. flying as a pilot for LOT. He returned to his former job with the company as soon as it restarted operations after hostilities ended. During his 32-year career with LOT, and including his war-time record, he has flown more than 1.8-million mi.

Most new pilots are drawn from the Polish air force, others from aero clubs. Before joining the carrier, prospective pilots must have completed at least 500 flight hours and 50 hr. simulator training.

Future LOT pilots then receive a minimum of 800 to 1,000 hr. additional theoretical instruction, 25-30 flight hours training and 20 hr. on the firm's Link trainer before they qualify for service as copilots.

UNITED
UNITED
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Viscount in New Uniform

Vickers Viscounts, formerly belonging to Capital Airlines, are beginning to appear in colors of United Air Lines, after extensive interior refurbishing and exterior repainting by United (AW Feb. 6, p. 50). United acquired 41 of the turboprop airliners when Capital was merged into it. They are being re-worked one at a time.

An additional 1,500 to 2,000 operational flight hours are then required before they graduate from copilot to first pilot status. To enable them to handle the more sophisticated Il-18s, pilots have to undergo further theoretical and practical training of up to 300 hr. in Russia. Every pilot serving with LOT also is subjected to a 2 to 3 hr. flight and 5 to 10 hr. simulator test twice a year—in the spring and fall.

London Airport Fees

London—Commercial aircraft overflying Britain will be charged for use of air traffic control, navigation and meteorological aids when British international airports are taken over by an airport authority in 1963-64.

British previously announced that airport users would be charged for these services (AW Aug. 7, p. 35).

Parliament must approve the plan, according to a White Paper on civil aerodromes, which outlined policy for an authority to assume control of London's Heathrow, Gatwick and Stansted airports and Prestwick in Scotland.

En route charges would be levied against airlines overflying the United Kingdom and using radar and radio aids, including traffic control, until passed to another nation. Methods of fee recovery would be determined by the new authority. Peter Thorneycroft, minister of aviation, said technical services now cost approximately $9 million a year.

Broad aim of the program, according to Thorneycroft, is to have the airports "break even" before considering lowering the fees. The fees for technical services would be in addition to landing fees at British airports, now considered among the highest in the world.

Despite its hard postwar struggle to re-establish itself and its present frustrations due to limited resources, LOT is making some progress, if slowly.

Compared with a total of 155,000 passengers and 3,360 U. S. tons of cargo carried in 1959, 200,900 passengers and more than 5,500 U. S. tons of freight were transported in 1960. International services presently cover a distance of 7,968 mi., LOT's domestic network 1,121 route mi. In 1960, aircraft movements at Warsaw-Okecie Airport totaled 12,625. A comparative figure for 1959 was not available. LOT says it is determined to increase its present operations threefold with a corresponding increase in revenue by 1965.

Ten foreign carriers serve the Polish capital on regular scheduled flights—British European Airways, Air France, Sabena Belgian World Airlines, KLM Royal Dutch Airlines, Scandinavian Airlines System, Swissair, Austrian Airlines, CSA Czechoslovak Airlines, Aeroflot and MALEV Hungarian Air Transport.

Recently, new air traffic control equipment was installed at Warsaw Airport and a new precision radar approach device will soon be added. The airport, situated about seven and a half miles from the center of Warsaw, has served its purpose ever since it came into service in November, 1933, but facilities are now limited, and LOT realizes the acute necessity of modernizing airport installations in order to meet modern transport aircraft requirements. Therefore, it plans next year to begin reorganizing its present reception center, booking offices, restaurant and administration buildings. Until now, they have been used for combined domestic and international operations, but new and much more spacious buildings to be constructed will serve international traffic, while the older facilities will continue to be used for domestic services. Warsaw Airport's main 6,560-ft. runway also will be extended to 9,840 ft.

In step with this airport modernization and reconstruction program, new downtown premises to be built will in the future house both the LOT air terminal and head offices, which have been located in two separate buildings in the city center.

LOT, with an initial fleet of a few four-seat Junkers F-13 and four-seat French Farman aircraft, soon began to extend both its domestic and international network. Gradually, eight-passenger Fokker F VIIs began to replace the older equipment; then several Fokker VII 10-seat aircraft built under license in Poland were added to the LOT fleet. In 1933, the first Polish-designed and built single-engine PWS-24 four-seat aircraft were introduced on the carrier's domestic routes.

LOT continued to develop its network and, parallel with this development, to modernize its equipment. Twin-engine Douglas DC-2s were introduced on LOT's routes on Nov. 1, 1935 and these were followed in rapid succession by Lockheed 10A Electras and 14H Super Electras. Simultaneously, the first twin-engine aircraft of Polish design, the PZL-44 Wicher, were put into service by LOT.

World War II destroyed LOT's beginning and future prospects. LOT personnel, pilots and equipment were scattered in every direction, but many of the personnel reported to work with their former company again as soon as hostilities ended and a semblance of order was restored in Poland.

Hughes' Jet Financing Hindrance Charged

New York—Delays and hindrance to its order for turbofan-powered Boeing 707s and for future orders for short-medium range jet transports like the Sud Caravelle emerged last week as a key factor in Trans World Airlines' suit against Howard Hughes.

The suit, filed in U. S. District Court here June 30 but sealed until last week, alleged violations of the Sherman and Clayton Anti-trust Acts on the part of Hughes and two other defendants—Hughes Tool Co. and Raymond M. Holliday, Hughes' representative in the three-man voting trusteeship for the Hughes 78% TWA stock holding.

Atlas Corp. and Northeast Airlines are not named as defendants but, partly because of a proposal for merger with Northeast which TWA described as disadvantageous to itself, they are named as co-conspirators. Atlas owns 58% of Northeast and Hughes 11% of Atlas.

Besides seeking $105 million in triple damages for alleged anti-trust violations specified in two claims and $10 million compensatory damages based on a third claim, plus punitive and exemplary damages the court might deem just, the suit also seeks:

- **Divestiture** by defendants of all interest in TWA stock.
- **Perpetual injunction** against the defendants or any employes or agents from attempting to exercise direct or indirect control over TWA.
- **Perpetual injunction** against the defendants threatening suit against TWA or its management for failure to act in the manner sought by the Hughes' interest or any act not favored by Hughes.
- **Perpetual injunction** against defendants' acquiring or holding TWA stock.
- **Perpetual injunction** against interfering with, obstructing or harassing TWA or its management.

Temporary injunctions also are specified, and obtaining such an order might be an early effort by TWA if it feels there is continued hindrance to its equipment order.

TWA ordered 20 707-131Bs and six 707-331Bs in May, dependent on TWA borrowing $147 million of the $187.5 million total cost (AW May 8, p. 39). Negotiations were under way with more or less the same group participating in TWA's financing last year, but with the addition of the Prudential Insurance Co. to the institutions previously committed—Equitable Life Assurance Society and Metropolitan Life Insurance Co.

Shortly afterward, Hughes attacked the validity of the Boeing order and the legality of the voting trust (AW June 5, p. 43) and raised the question of TWA's liability for purchase of 13 Convair 990s on order by Hughes Tool Co.

"As a result of such warnings," the TWA suit alleged, "at least one of the proposed lenders has completely withdrawn from all negotiations for the proposed financing, and TWA's efforts to obtain such financing have been handicapped."

The 707 order still is firm, despite the financing problems. A possible TWA Caravelle order is another matter. In listing the alleged injuries, the complaint notes how its efforts to finance the Boeing order have been impaired, then adds:

"TWA's ability at this time safely to order additional jet-powered aircraft which it urgently needs has been handicapped. The date when additional jet-powered aircraft will be available to and will be in use by TWA has been deferred."

The complaint alleges a pattern of offenses dating back to 1939, but for the most part deals with the period beginning in 1955 when jet transport orders were becoming a reality. Basically the complaint alleges the Hughes group conspired and combined to restrain trade by forcing TWA to rely on it for aircraft financing, providing such financing only if aircraft were acquired from Hughes Tool, and forcing TWA to boycott other suppliers.

Also raised is the question of attempts to restrain domestic and foreign commerce through control of TWA as a substantial supplier of air transportation. In effect, this seeks to make harm to the public as well as private injury an issue.

Prior to 1955, the complaint says, Hughes and General Dynamics Corp. agreed to develop a jet transport known as the Model 18, for which TWA would supply a "captive market." About the time the Model 18 was dropped—October, 1955—Pan American World Airways, a principal competitor of TWA, placed the first firm jet order with a U. S. manufacturer, the complaint said.

While other carriers followed with jet orders, through early 1956, Hughes developed a plan for Hughes Tool to manufacture an aircraft called the Golden Arrow, which at mid-year also was dropped.

In the meantime Hughes Tool ordered 15 Boeing 707-131s and 18 Boeing 707-331s and resumed negotiations with General Dynamics which resulted in orders for 30 aircraft originally known as the Convair 600 Skylark, later the Golden Arrow, finally as Convair 880.

Hughes Tool reserved the right in its purchase contracts with the manufacturers to assign TWA the aircraft, but, the complaint alleged, refused despite repeated requests between 1956 and 1960 to assign TWA the rights to acquire these aircraft. In June, 1959, the complaint continued, Hughes released six 707s to Pan American.

During this same period, Hughes required Convair to make modifications in the 880, the complaint said, but prevented TWA from arranging for design modifications it sought.

Jet aircraft were made available to TWA on a day-to-day lease basis in 1959 and 1960, the complaint said, but these were inadequate to TWA's needs, and the leases restricted TWA from dealing with other aircraft suppliers.

By 1960 the merger proposal with Northeast had been made, and in November Hughes Tool released six of

Hughes Asks Dismissal, Resists Appearance

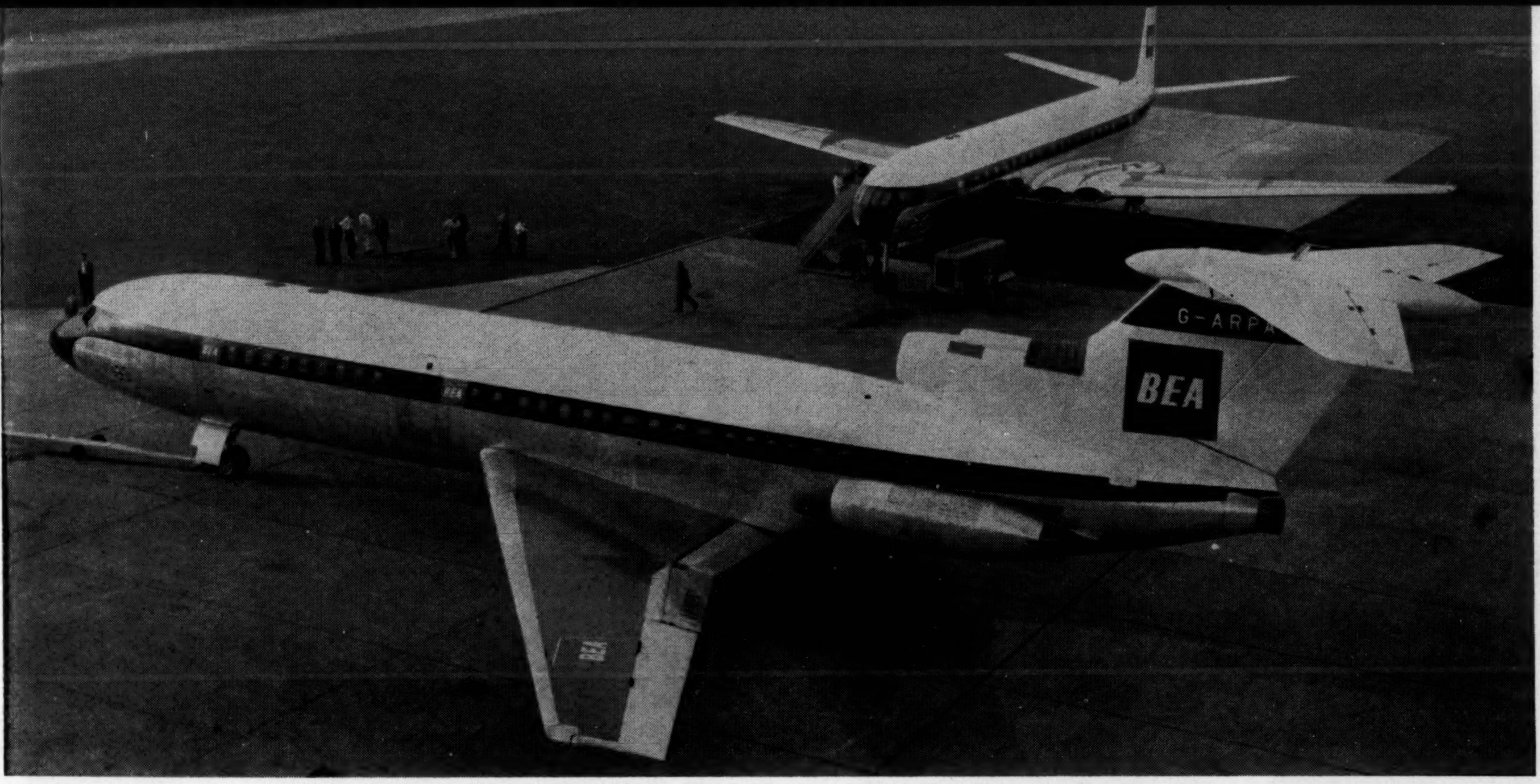
Hughes Tool Co. replied to the TWA anti-trust suit last week with a motion to dismiss, contending that dealings of Hughes Tool with TWA were subject to and approved by the Civil Aeronautics Board, thus exempting them from the anti-trust laws even if applicable.

Chester C. Davis, general counsel for Hughes Tool, filed a supporting affidavit asserting also that the proposed loan for TWA's new jet order was not competitive and was self serving to the lenders in that it was an attempt to perpetuate the voting trust beyond the termination originally agreed upon.

Initial steps in the suit last week were efforts by TWA to gain a court order to require Hughes personally to give depositions, and the presentation by both sides of schedules for taking of depositions of other parties and witnesses.

John F. Sonnett, a partner of Cahill, Gordon, Reindel & Ohl, attorneys representing TWA at the court proceedings told Federal Judge William B. Herlands in U. S. District Court, Southern District of New York, that he wants to examine Howard Hughes in person on the witness stand so Hughes will be required to give sworn testimony. Davis replied that Hughes Tool would have other corporate representatives give sworn testimony, but that Hughes does not want to testify because he prefers not to appear in public.

"The man is an eccentric," Davis told the court, "but that's no reason for taking away his property."



First de Havilland Trident Transport Rolls Out

First de Havilland Trident (foreground) three-jet transport last week was rolled out at the firm's Hatfield plant, about one month ahead of schedule. Trident, whose direct competitor is the Boeing 727, will start its flight testing this winter. Powerplants are three aft-mounted Rolls-Royce Spey turbojets of 9,850 lb. thrust each (AW June 5, p. 59). British European Airways has ordered 24 Tridents for short-to-medium-range hauls. Initial batch of seven is scheduled for the Hatfield production line. Comet is visible in background.

its 880 order to Northeast, including three aircraft Hughes Tool had assigned to TWA by agreement in May, the complaint said.

The Hughes group and Atlas Corp., the petition alleged, had earlier caused Northeast to submit a merger proposal to TWA on terms which were disadvantageous to TWA but advantageous to Northeast in order to:

- **Enlarge TWA's requirements** for new aircraft, "and thereby to enlarge the demand in the market from which the defendants had foreclosed and would continue to foreclose all other suppliers."
- **Enable Atlas** to obtain stock of TWA on terms advantageous to Atlas and its stockholders, including Howard Hughes.

After its new management took over, TWA began to take a new look at the merger picture though not completely dropping the Northeast plan (AW May 15, p. 52). Hughes and Atlas have continued to demand TWA accept the merger on the previous terms, however, the complaint said.

The complaint takes up the financing problems of TWA, charging that the Hughes group refused to let TWA engage in equity financing unless Hughes Tool was allowed to increase its equity position in the airline. TWA thus was forced to depend on the Hughes group for financing, the complaint said. Because of delays in obtaining the financing program to which Hughes eventually agreed last year (AW Jan. 9, p. 38), TWA paid 6½% instead of 4½% for funds and lost opportunities for early sales of obsolescent piston transport aircraft the complaint said.

TWA's financing plan included a $110-million debenture issue, which was offered to stockholders through rights issued on the basis of common stock held. The debentures were placed on the market in May, about the time TWA revealed its new jet order and was negotiating to finance it.

During this period, the complaint said, the Hughes group:

- **Attempted to coerce** TWA into purchasing the Convair 990s from Hughes Tool instead, asserting that TWA might have an obligation to buy the Convair airplanes, that the Boeing order was not in TWA's best interest, and threatening suits against TWA in telegrams and messages to the airline, the directors, voting trustees and financial institutions.
- **Warned Boeing** that its contract with TWA was not binding.
- **Raised objections** with the Securities and Exchange Commission as to the debenture issue on similar grounds.
- **Announced plans to sell** up to 85% of the rights to purchase debentures, thus driving down the price of the rights which were salable on the open market.

The three claims generally cover the same acts but are divided into:

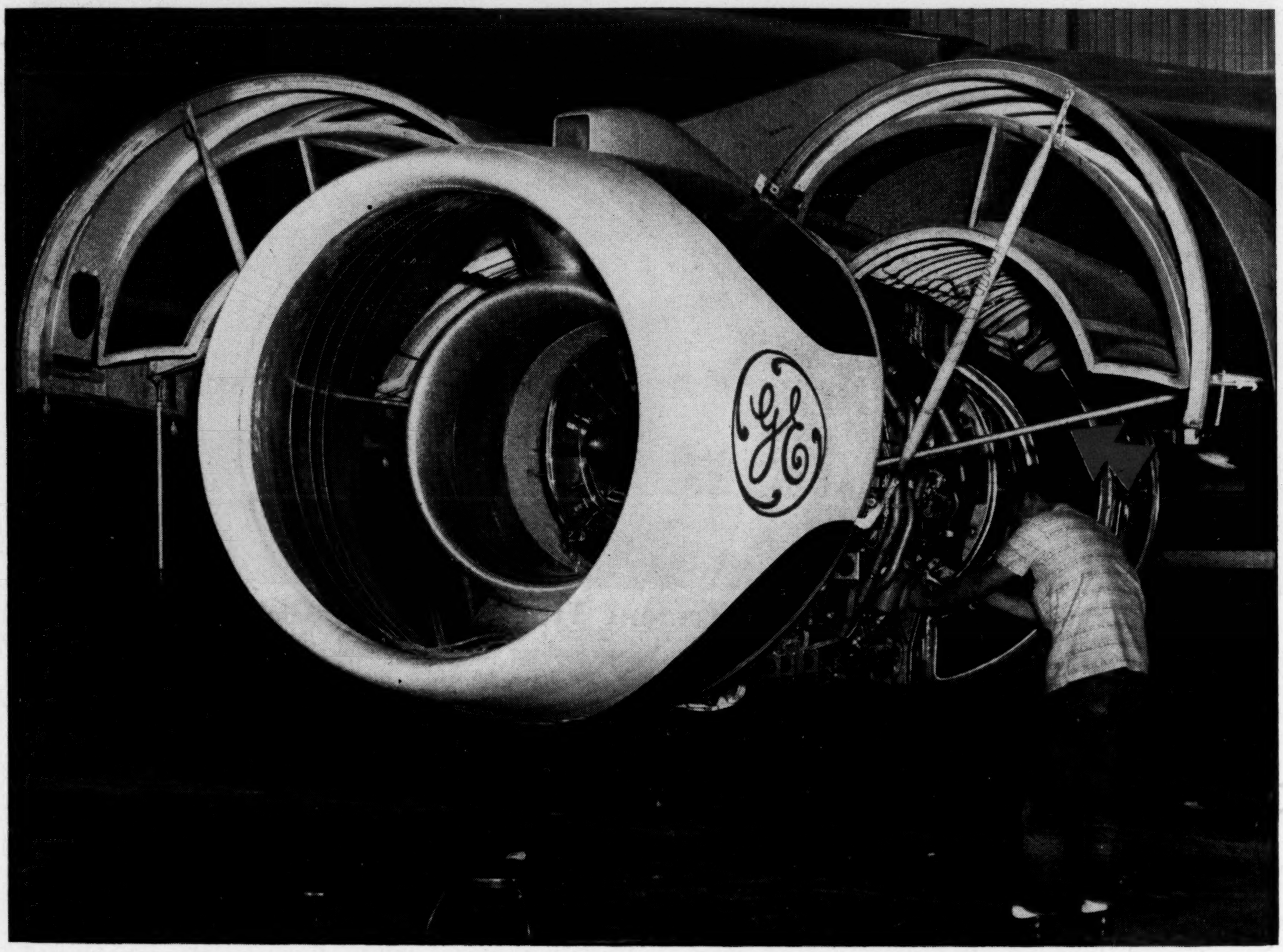
- **Claim I** covering the entire period from 1939 to June 30, 1961, the date the suit was filed and alleging violation of both the Sherman and Clayton Antitrust Acts.
- **Claim II** covering the period December, 1960, to June 30, 1961, the period in which the voting trustees and new management have controlled the airline. This also alleges Sherman and Clayton Act violations.
- **Claim III** covering the same period as Claim II but citing general principals of law and equity as well as violation of statutes and particularly aimed at what are alleged as malicious acts—the attempt to interfere in the Boeing order, for example.

Actual damages in the first two claims are estimated at $35 million, which can be tripled under the antitrust acts. The $10 million damages in Claim III are not covered by this tripling provision. Additional damages could be sought later for acts alleged since the filing of the suit.

Section 7 of the Clayton Act is specifically cited in alleged violations in the complaint. This deals with use of stock interest to monopolize and control regardless of intention, and led to the Supreme Court's divestiture order in the case of du Pont's holding of General Motors stock.

TWA Losses

Trans World Airlines lost $11,724,000 after tax credits during the first six months of this year, compared with a $4,000 profit for the same period of 1960. June 1961 net profit was $547,000, down from $4,436,000 for June 1960. TWA offered 92,634,000 more available seat miles during the first half of 1961, flew 292,747,000 fewer revenue seat miles. System passenger load factor declined from 63.6% to 55.3%.



40% MORE THRUST. Special "aft-fan" (arrow)—driven by exhaust—forces the CJ-805-23 engine to swallow more air . . . increases thrust by 5,000 lbs. . . . ups speed to 640 mph, and provides better specific fuel consumption.

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The General Electric CJ-805-23 engine you see here is a "souped-up" adaptation of the Texaco-lubricated CJ-805-3 which now powers one of the world's fastest passenger jets. With nearly 40% more thrust, this new engine can boost flying speed to 640 mph—setting a new top speed for passenger jets.

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Joint Interline Booking System Considered

By L. L. Doty

Washington—Electronic system for the handling of all interline reservations on a nation-wide scale through a single computing center now appears to be the leading candidate to become the industry's standard interline procedure.

Developed by the Remington Rand Univac Division of Sperry Rand Corp., the system—called AID for Airline Interline Development—will require adoption by all 24 domestic airlines for full success at the low cost of operation proposed by Univac. Thus far, 10 airlines have given "certificates of interest" to Univac.

The company feels that once a substantial number of certificates of interest have been received, contracts can be negotiated as a prelude to launching installation of the system. Airlines which have indicated interest are Allegheny, American, Delta, Eastern, Mohawk, North Central, Northeast, Northwest, Ozark and United.

AID can be available within 18 months after the entire industry has agreed to accept the system. It can be linked to offices of foreign flag carriers for interline reservations on international routes and can be used for interline cargo reservations. It also could be tied in with travel agents and car rental offices. Full cost to the airlines, including installation of equipment, maintenance and rentals, has been estimated at 12 cents per message.

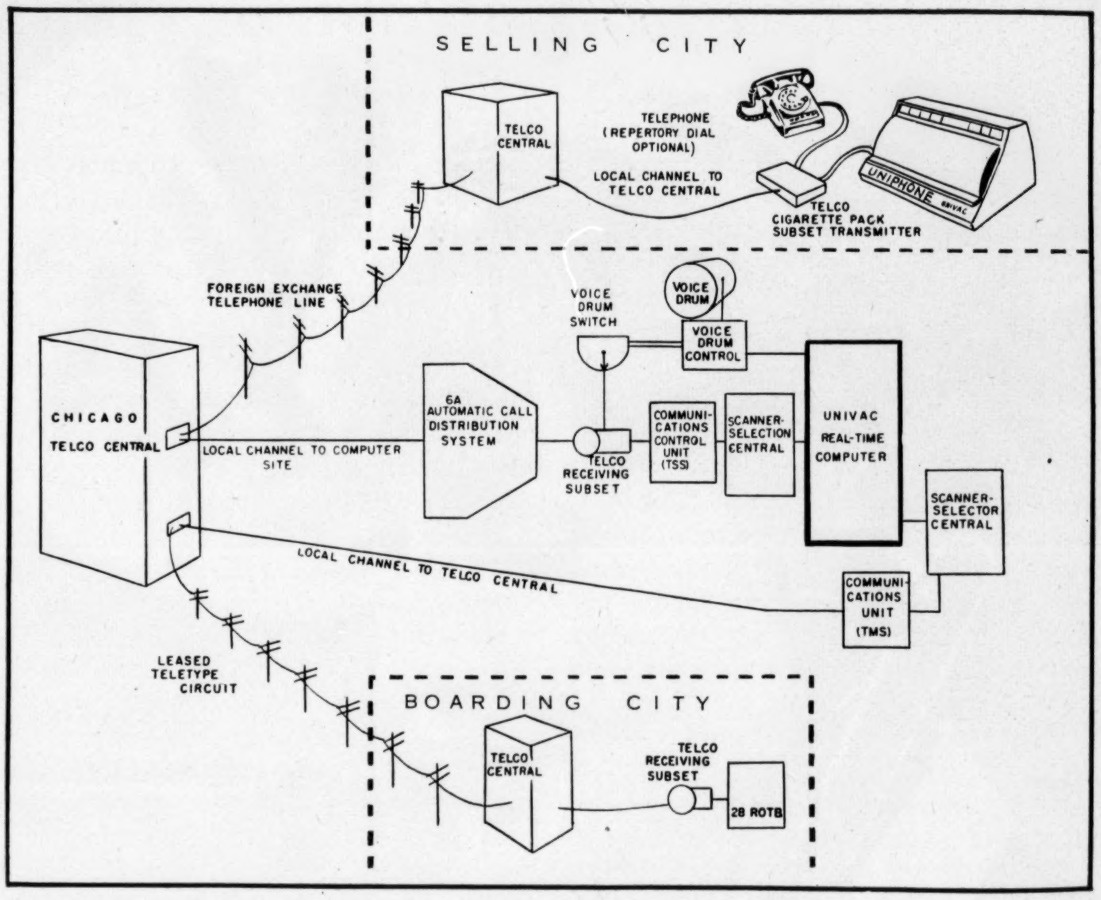

SELLING CITY
TELCO CENTRAL
TELEPHONE (REPERTORY DIAL OPTIONAL)
LOCAL CHANNEL TO TELCO CENTRAL
UNIPHONE UNIVAC
TELCO CIGARETTE PACK SUBSET TRANSMITTER
FOREIGN EXCHANGE TELEPHONE LINE
VOICE DRUM SWITCH
VOICE DRUM
VOICE DRUM CONTROL
CHICAGO TELCO CENTRAL
LOCAL CHANNEL TO COMPUTER SITE
6A AUTOMATIC CALL DISTRIBUTION SYSTEM
TELCO RECEIVING SUBSET
COMMUNICATIONS CONTROL UNIT (TSS)
SCANNER-SELECTION CENTRAL
UNIVAC REAL-TIME COMPUTER
SCANNER-SELECTOR CENTRAL
LOCAL CHANNEL TO TELCO CENTRAL
COMMUNICATIONS UNIT (TMS)
LEASED TELETYPE CIRCUIT
BOARDING CITY
TELCO CENTRAL
TELCO RECEIVING SUBSET
28 ROTB

DIAGRAM outlines proposed electronic interline booking system arrangement.

Central Computing Facility

Heart of the AID system is a central computing office which would be located in Chicago and be accessible from every airline reservations office in the nation. Communications between the computing center and the airlines is to be maintained through a nation-wide network of 152 telephone lines and 21 Teletype lines.

Under the AID approach, messages are transmitted to the computing center through the communications systems by means of a Uniphone, an inquiry-answer device which can be attached to any existing telephone trunk. The Uniphone can transmit 35 different types of alphabetic or numeric messages at a speed of about 20 characters per second. All messages receive an immediate, automatic voice reply.

The system works on the principle that all interline space is available for immediate sales unless a "stop sales" message on a given flight has been fed into the computer, in which case the selling airline is told by the central computer that space is unavailable. If a flight has not been so posted, the space is then confirmed by the computer.

Under normal conditions, the time required on the part of a reservations agent to request interline space and to receive either a "confirmation" or "unable" is about 35-45 sec. Although most carriers can promptly confirm space on the vast majority of their flights, several hours are required under today's system to process a request for seats and obtain a definite answer.

The Uniphone, which measures 18 in. by 12 in. by 9 in., is an alpha-numeric input device containing 40 manually operated levels which actuate the same number of wheels within the unit. To form a message, levels are moved vertically by the reservationist and are positioned at the proper letter or number imprinted on the face of the Uniphone. There is one such imprinted alphabetic-numeric reference guide for each lever.

As the operator pulls each level downward to the desired character, the message form is displayed automatically in windows on the upper portion of the Uniphone. A spring-loaded detent on each wheel prevents the wheel from drifting.

The basic module is an assembly consisting of a support plate, wheel drive, positioning lever and a printed circuit commutator bonded to one quadrant and a brush assembly for code sensing.

One quadrant of the drive wheel is geared and rotates an associated digit display wheel mounted with other digit display wheels on a common shaft. As the operator pulls the lever downward to the desired character on the face of the device, the drive wheel rotates. This sets up the coding and positions the selected character in the message display window.

A completed request message will include the desired flight number, class of service, day and month of flight, origin and destination, passenger's name and on-line arrival flight and date.

Telephone Network

Once the message is set up on the Uniphone, the reservationist dials the proper number on the telephone attached to the Uniphone to get a direct connection with the computer center. The private telephone lines would terminate in 131 cities and each line would be assigned a Foreign Exchange number which could be dialed direct through a local exchange or, from a remote city, using Direct Distance Dialing to make a connection with the Foreign Exchange network. In cities where dial equipment is not available, the central office operator will establish the connection with the Foreign Exchange line.

When it is necessary to transmit messages through the computer center to the receiving airline or airlines, private line Teletype circuits terminating in the receiving airlines' relay centers are to be used.

The agent knows that a connection with the computer center has been made when the ringing sound of the

Dear American Airlines:
Recently your reservations people helped me complete a lengthy trip with an involved itinerary. Their graciousness and knowledge were exceptional. It was a pleasure to have their help.
Chris D. McKeon

UNSOLICITED LETTER FROM MR. C. D. MCKEON, MCKEON CONSTRUCTION CO., SAN FRANCISCO, CAL.

The voice of American, Mr. McKeon, is friendly and expert at solving travel problems. Even in busy vacation months, our standard is to answer 90% of our phone calls in 20 seconds. Prompt, courteous service is a good reason why American is *first choice of experienced travelers.*

AMERICAN AIRLINES
America's Leading Airline

telephone ceases. The computer receives the message and then checks the following points:

- **That the proper number** of message characters have been included.
- **That the message format** conforms with established standards and whether additional messages are forthcoming.
- **That time interval** between the arrival of the delivering flight and departure of the receiving flight is equal to or exceeds prescribed minimum limits.
- **That the receiving flight** operates between cities specified and that the delivering flight operates from the boarding point specified.
- **That both receiving** and delivering flights operate on the day of the week or date of the month requested and that space is available on the receiving flight and the sale is acceptable.
- **That the transaction** is not a duplication.

Upon completion of these checks, the computer transmits to the telephone connected with the Uniphone a voice answer. The computer then stores the passenger's name, flight and date, converts the record to the particular format of the receiving airline and transmits a booking message to the boarding point or Teletype switching center of the receiving airline.

South American Route Investigation Ordered

Washington—Civil Aeronautics Board last week ordered an investigation to determine whether U. S. carrier competition in South America should be reduced by modifying or canceling certificates now held by Pan American, Panagra, Braniff and Delta airlines.

The order was based on a Board study of the South American route structure, which concluded that U. S.-South American traffic needs can best be met by a balanced route structure providing for two carriers which separately serve the east and west coasts of the continent, are non-competitive except at Buenos Aires and provide service to U. S. gateways presently used.

In its order, the Board noted that basic changes in technology and service patterns have occurred since the route pattern was established in the South American area. It said that in 1944, Pan American and Panagra operated in competition with three South American carriers, while today 19 South American flag carriers are authorized to serve the U. S. market.

CAB ordered hearings in the case and directed that the proceedings be conducted in two separate phases; one dealing with the route pattern to be established, the second with the selection of the carrier or carriers to serve such routes.

Hijacking of Pan American DC-8 Spurs Action on Preventive Bills

By Robert H. Cook

Washington — Government concern over a mounting wave of aerial hijacking was underscored by the diversion of a Pan American World Airways DC-8 to Cuba last week as Congress moved to adopt new penalties and President Kennedy ordered preventive measures.

The President warned against becoming "over excited" about the incidents, observing that a "lunatic fringe" has seized upon this technique. In addition to Border Patrol protection on some flights, the President asked airlines to strengthen cockpit doors and keep them locked with keys held only by the crew in the cockpit.

The Pan American DC-8, with 71 passengers and 9 crew members, was released by Cuba after appeals from the State Department, the Mexican government and the airline. Cuban militiamen arrested the hijacker, identified as Albert C. Cadon, a 27-yr.-old itinerant artist from Paris. He reportedly claimed he stole the Pan American aircraft to protest Washington's handling of the Algerian situation. Cadon will be charged with crimes on the high seas, according to the FBI.

En route to Guatemala and Panama from Mexico City, the DC-8 was commandeered shortly after takeoff, airline spokesmen said. Unable to convince the hijacker that the 10,600 ft. Havana runway is too short for a turbojet transport landing, the pilot altered course and landed at the Cuban capital.

About the time the Pan American aircraft was landing in Havana, anti-Castro Cubans made an abortive attempt to hijack a Cuban DC-3 en route from Havana to the Isle of Pines.

Meanwhile, the State Department received a reply from Cuba on an earlier request that an impounded Eastern Air Lines Electra be returned. The reply, routed through the Swiss diplomatic service, proposed a reciprocal agreement for automatic release of aircraft or boats hijacked in either country, denounced the U.S. press and government for an "aggressive attitude" in blaming Cuba for recent hijackings carried out by non-Cubans, and demanded the release of a Cuban patrol boat seized by anti-Castro defectors, State officials said. The note implied that the Electra might be released if the two governments reach an over-all agreement, they said.

The aggression charges were also filed with the United Nations Security Council, along with a Cuban offer to place the question of disposal of the Electra before the council.

Capture of the DC-8 brought new demands for congressional action to avert further hijacking incidents, and it was expected to accelerate the passage of new legislation designed to impose a life sentence for this type of crime. The Federal Aviation Agency, which earlier authorized the arming of airline pilots and other protective measures, has backed a Senate measure on hijacking penalties, and several similar bills are before a House aviation subcommittee.

Airlines have quietly adopted a number of precautionary procedures, ranging from locking the cockpit door to carrying armed guards. Most carriers indicated that the possible danger to aircraft and passengers might be increased by permitting pilots to be armed. Their stand is strongly endorsed by ALPA.

Pan American said it has no plans to cancel its two daily round trips between Miami and Havana. Delta Air Lines, which operates one trip a week through Havana, also said it expects to retain the service.

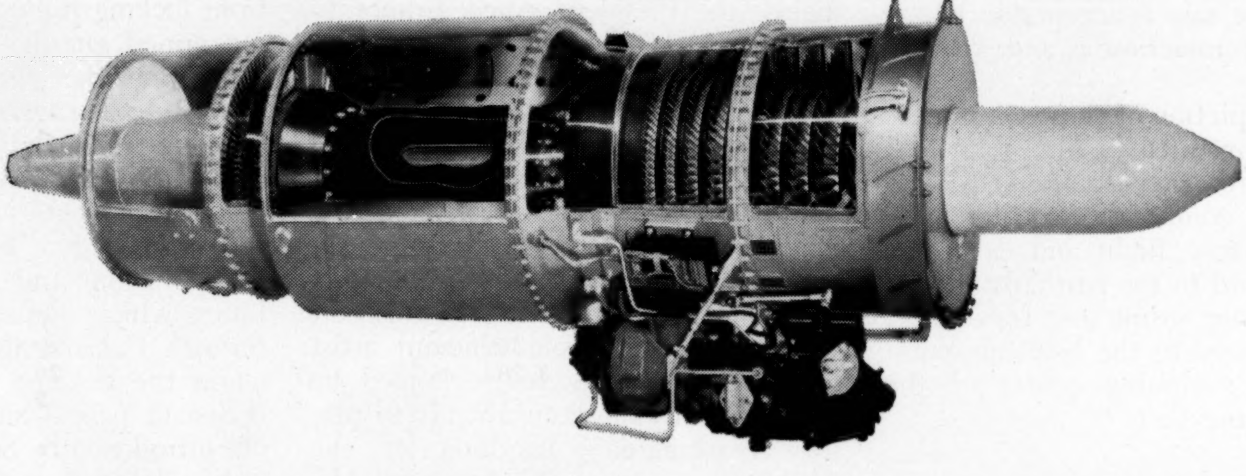
Senate passed an "acts of violence" bill introduced by Sen. Clair Engle (D.-Calif.), late last week. The bill makes it a federal violation to intimidate, assault or interfere in any manner with flight crews and calls for a $10,000 fine or imprisonment for 20 yr., or both. If a dangerous weapon is used, the penalty could be either life imprisonment or death. It would also make the carrying of any concealed weapon on an aircraft a crime punishable by a fine of $1,000 or one year in prison, and it calls for the hijacking of airline transports to be judged under current laws and penalties covering piracy on the high seas.

Adoption of a House bill may be delayed by complex legal issues involving state versus federal jurisdiction.

The Pan American hijacking was the fifth such incident since May 1, when a National Airlines flight was forced to land in Havana. The aircraft was later released. On July 24, an Eastern Air Lines Lockheed Electra was comandeered and forced to land in Havana. One week later an attempt to hijack a Pacific Air Lines DC-3 failed and the captain, an airline agent and a passenger were wounded by the armed hijacker.

Continental Airlines narrowly missed losing a Boeing 707 Aug. 3, when law enforcement officials crippled the transport with gunfire as it began to taxi from El Paso, Texas airport en route to Havana. Subdued by FBI and Border Patrol agents after a 10-hr. siege, a father and son from Arizona were charged with kidnaping and transporting a stolen aircraft across state lines.

J60



WHAT WILL THIS VERSATILE TURBOJET DO NEXT?

Pratt & Whitney Aircraft's J60(JT12) jet engine, which weighs only 436 pounds yet produces 3,000 pounds of thrust, has demonstrated its versatility in a broad range of applications.

For the United States military forces, it powers the T-39 twin-engine trainer, the C-140 four-engine utility transport, and the SD-5 reconnaissance drone. It supplies power for the Canadian Air Force CL-41 single-engine trainer. The world's fastest executive transport uses the J60 which also has been ordered for a West German high altitude research glider.

Add a free turbine, and the J60 becomes a turboshaft engine, developing 4,050 shaft horsepower. Two of these turboshaft engines will give advanced helicopters power to lift nine tons. This version of the J60 is also projected for VTOL aircraft.

A modified J60 for industrial uses will supply power for pumps, compressors, electric generators—and can be adapted for use in ships and heavy earth-moving vehicles.

Whatever its application, the J60's simple, rugged design ensures high reliability and easy maintenance.

Pratt & Whitney Aircraft
Division of **UNITED AIRCRAFT CORPORATION**
East Hartford, Connecticut

PRATT & WHITNEY AIRCRAFT
DEPENDABLE ENGINES

Airline Traffic—June 1961

	Revenue Passengers	Revenue Passenger Miles (000)	Passenger Load Factor %	U. S. Mail Ton-Miles	Express Ton-Miles	Freight Ton-Miles	Total Revenue Ton-Miles	Over-All Load Factor %
DOMESTIC TRUNKS								
American	725,506	577,103	67.5	2,019,563	947,952	11,042,148	69,293,077	58.0
Braniff	194,433	94,791	60.7	385,650	178,243	936,377	10,587,663	48.3
Continental	123,110	81,799	48.1	224,556	117,907	700,793	8,882,390	40.6
Delta	314,142	188,147	63.0	626,746	342,908	1,608,116	20,640,377	53.1
Eastern	704,556	351,993	53.3	1,260,801	513,956	2,459,049	38,096,035	42.5
National	143,155	95,262	53.4	360,433	67,864	878,952	10,482,406	40.8
Trans World	450,055	422,847	63.0	1,523,884	753,570	5,108,656	47,885,151	50.4
United	1,081,373	739,521	63.5	4,150,697	1,366,427	8,491,115	84,877,431	55.6
Western	140,315	86,200	60.2	293,840	100,680	378,152	9,017,095	47.8
INTERNATIONAL								
American	6,544	7,119	49.2	6,490	755	335,557	1,079,552	44.6
Braniff	8,712	13,526	52.0	68,227	....	167,500	1,661,050	44.5
Caribbean Atlantic	33,032	2,321	67.4	2,669	....	9,925	228,633	67.0
Delta	1,620	2,264	47.2	662	....	9,401	251,720	44.3
Eastern	47,223	69,705	66.1	158,283	....	430,257	7,123,006	57.3
Mackey	10,372	1,727	50.0	....	188	4,888	174,716	49.9
Pan American								
Alaska	7,485	8,143	48.5	49,420	4,927	217,580	1,119,567	45.8
Atlantic	167,781	245,861	53.8	2,673,018	....	4,398,141	32,473,179	47.0
Latin America	115,703	152,839	65.1	509,567	....	4,075,007	20,072,986	63.0
Pacific	47,243	175,312	71.1	3,288,266	12,739	2,940,908	24,311,645	61.0
Panagra	10,099	18,100	59.3	93,324	....	644,543	2,694,306	57.4
South Pacific	146	400	36.5	316	....	2,585	43,717	31.9
Trans Caribbean	11,682	17,703	74.9	....	....	262,216	1,747,894	75.3
Trans World	33,839	115,842	51.9	1,513,319	....	1,605,641	14,996,089	47.7
United	21,405	53,276	75.9	217,494	11,523	180,314	5,830,970	55.6
Western	5,109	7,918	48.7	10,940	....	36,726	862,615	41.0
LOCAL SERVICE								
Allegheny	85,112	17,666	47.9	24,432	39,055	78,176	1,826,240	51.2
Bonanza	26,102	6,394	45.5	7,660	2,728	12,833	636,781	46.6
Central	22,833	4,245	36.2	13,994	8,679	21,794	451,181	34.6
Frontier	32,352	8,766	38.7	28,170	11,957	66,826	947,516	41.3
Mohawk	70,067	14,958	48.3	22,274	26,898	33,613	1,510,417	45.9
North Central	96,812	18,053	45.4	48,297	50,497	71,332	1,885,121	45.6
Ozark	52,527	9,364	46.4	21,343	29,920	36,818	982,155	50.7
Pacific	42,725	9,988	51.8	16,150	4,339	9,070	982,249	52.0
Piedmont	48,740	10,364	50.3	15,250	17,374	25,938	1,051,638	51.6
Southern	35,876	6,471	35.4	23,713	14,681	27,698	686,008	37.4
Trans-Texas	28,729	6,767	37.4	20,963	9,896	46,815	724,917	38.3
West Coast	35,254	8,681	47.1	15,569	6,181	30,716	881,490	47.9
HAWAIIAN LINES								
Aloha	33,477	5,024	65.2	2,799	....	5,804	411,315	55.4
Hawaiian	46,203	6,882	64.2	4,486	....	154,949	712,171	63.0
CARGO LINES								
Aerovias Sud Americana	....	....	......	....	....	242,868	242,868	75.7
Flying Tiger	7,389	37,809	69.6	21,433	30,592	6,743,210	10,576,210	70.5
Slick	3,648	24,594	95.9	....	....	401,501	2,860,907	95.0
HELICOPTER LINES								
Chicago Helicopter	23,569	414	48.2	1,234	....	....	40,699	40.1
Los Angeles Airways	4,476	162	61.8	4,832	2,425	....	22,742	68.1
New York Airways	15,160	270	53.7	1,877	737	683	29,075	50.9
ALASKA LINES								
Alaska Coastal	6,107	600	56.4	3,898	....	6,436	71,279	60.3
Cordova	2,854	388	50.3	3,884	....	59,449	101,708	57.5
Ellis	6,186	398	49.7	2,203	....	3,987	46,323	57.9
Kodiak	1,362	99	40.0	492	....	1,557	11,871	37.4
Northern Consolidated	4,545	1,443	49.8	53,011	....	151,821	360,967	65.7
Pacific Northern	14,813	15,072	63.1	148,038	9,251	460,457	2,247,216	75.1
Reeve Aleutian	1,602	1,645	44.0	55,070	....	155,340	390,389	60.3
Western Alaska	1,889	77	79.0	770	....	9,657	17,861	81.0
Avalon	8,768	395	53.0	778	....	674	38,939	55.1

Data for Northeast, Northwest, Lake Central, Riddle, Seaboard World, Alaska and Wien Alaska was not available.
Compiled by AVIATION WEEK from airline reports to the Civil Aeronautics Board.

Four ways to tell a true airlifter

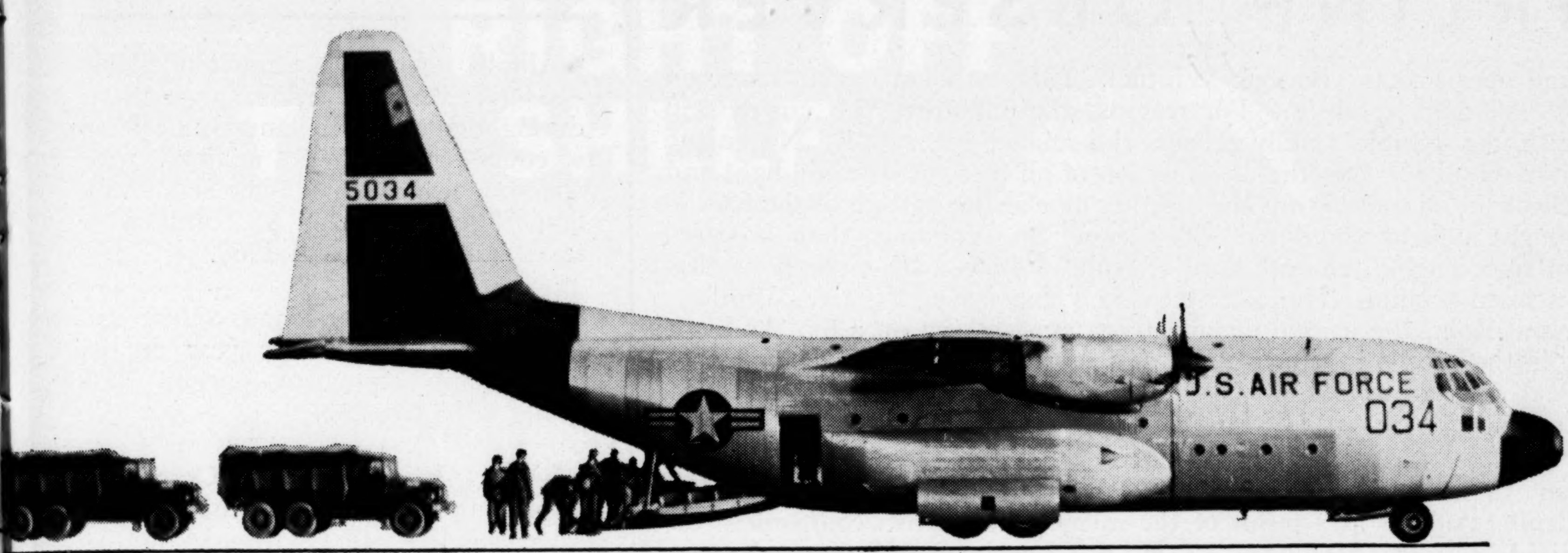
1. Loads from the rear

US ARMY
41217541
3A-600 E
PB-4

2. Truck-bed height

33387
LOCKHEED

A true airlifter is a special breed of bird—built without compromise for its special kind of wor Huge rear doors allow cargo to be loaded straight in. Cargo floor is truck-bed height; no hoisting cargo u and jockeying it around corners. Rear doors can be opened in flight for bulldozer-size paradrops. And true airlifter need not be pampered with paving. It lands and takes off in sand and rough dirt, close t the action, just like a bush plane. Lockheed's C-130 Hercules propjet is the true airlifter. Now in its secon million miles of operation, 14 different versions are flying or being built for the U.S. Air Force, Navy Marines, and Coast Guard—and for the air forces of Canada, Australia, and Indonesia. Newest model C-130E, will soon haul huge cargoes on MATS' worldwide routes. The big Lockheed/Georgia carg jets of the future will be true airlifters, too; they will have the same four basic attributes Hercules has


5034
U.S. AIR FORCE
034

3. Paradrops big equipment

4. Lands on short, rough fields

U.S. AIR FORCE

U.S. AIR FORCE
3063
USAF

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AIRLINE OBSERVER

▶ Airlines operating the Pratt & Whitney JT3D turbofan engine have run into an "oil gulp" problem. For reasons still unknown, the engine will begin to throw oil and rapidly exhaust the small 6-gal. supply. No engine damage has resulted, since the combination of oil pressure warning light and visual check for oil running out the breather pipe at the bottom of the nacelle has brought inflight shutdown. It is more an economic than a safety problem since engine removal usually results, followed by inspections that have disclosed nothing. The oil itself is very expensive. Pratt & Whitney, Boeing and Rohr, the nacelle manufacturer, are working on a fix. Ambient heating in the nacelle is being studied as a source of temporary distortion of an oil seal, which reseats itself when the heat is removed leaving no clue to the leak.

▶ United Air Lines is rapidly disposing of piston-engine aircraft inherited from Capital Airlines as a result of the merger of the two companies. So far, United has sold 10 Douglas DC-4s, five Lockheed 049 Constellations and two DC-3s.

▶ Eastern Air Lines is crediting the popularity of its Washington-New York-Boston commuter service not so much to the low fares but to highly dependable performance. The carrier has found that many regular passengers on the high-density route are switching to the shuttle service because of easy loading and unloading, frequency of schedules and a near-perfect on-time record.

▶ Cracked engine nacelles due to high temperatures reportedly are the main reason why all Il-18 turboprop transports in service were grounded and flown back to Moscow for modification following an Aeroflot Il-18 crash last summer (AW Aug. 29, 1960, p. 45). Since then, CSA Czechoslovak Airlines has lost two Il-18s—one at Forchheim, Germany, in March and one at Casablanca in June. But according to some Il-18 operators, the modifications undertaken in Moscow last summer solved the engine-nacelle design problem.

▶ Sen. A. S. Mike Monroney (D.-Okla.) has asked the State Department, Civil Aeronautics Board and Federal Aviation Agency to give air cargo priority treatment in the negotiation of international bilateral air transport agreements. Sen. Monroney said that "our international passenger agreements are enough of a mess without duplicating the confusion in the cargo field in the face of an opportunity to create a rational system."

▶ Federal Aviation Agency will install visual glide slope indicator lights at 37 airports following first delivery of the units in September. System, developed by the British Royal Aircraft Establishment, consists of 12 light units arranged in three-unit bars set on each side of the runway. Lights can be seen in daytime and under limited visibility conditions as well as at night.

▶ Dutch government has told the State Department it will protest any Civil Aeronautics Board attempt to rule on KLM's request for West Coast landing rights. The Dutch hold that KLM operating rights in the U. S. were established in the 1957 bilateral air transport agreement between the U. S. and The Netherlands, and that the CAB has no jurisdiction over such agreements.

▶ British Overseas Airways Corp. appeal against an Air Transport Licensing Board transatlantic route grant to Cunard Eagle Airways (AW July 31, p. 42) will cite a drop in this summer's transatlantic air traffic. BOAC will claim that the poor results this year indicate that forecasts on which the Board's decision was based are likely to prove over optimistic. Hearing has been set for Sept. 26.

▶ Bilateral air transport agreement has been signed between the Iraqi Republic and Poland for direct Polish-Iraqi air service.

SHORTLINES

▶ **Alitalia** reports a net profit of $178,383 for its international operations during 1960. The Italian airline's 1960 revenues were $75.3 million, with operating expenses totaling $66.9 million. The carrier paid $8.2 million in taxes and other costs in 1960.

▶ **American Airlines** reports 6,000 passengers have flown this year on its "flightseeing" program, begun last spring in 15 cities.

▶ **British Overseas Airways Corp.** will open four new U. S. sales offices: Los Angeles, Aug. 14; Hartford, Conn., Sept. 11; Newark, N. J., Oct. 30, and Honolulu, Nov. 6.

▶ **Eastern Air Lines** has begun a year-long research program to find improved methods of forecasting high altitude and clear-air turbulence.

▶ **El Salvador** will expand and modernize its Ilopango International Airport at the capital, San Salvador, to include a 7,000-ft. runway. VOR facilities, glide path indicators and wider taxiways and aprons. U. S. has loaned $1.6 million for local construction costs and Export-Import bank has lent $2.6 million for U. S. construction costs.

▶ **KLM Royal Dutch Airlines'** "TAG" (Time Arrival Guarantee) plan allows shippers to insure, at 1% of shipping costs, against arrival time delays. If a shipment is more than 24 hr. late, transportation charges are reimbursed.

▶ **National Airlines** has begun cargo service from Miami to Los Angeles via Orlando, Tampa and Houston with two 1049-H Super Constellation aircraft, making five round trips a week.

▶ **Polysonics,** Washington aviation acoustical consultants, will conduct a study of aircraft noise for Federal Aviation Agency at selected airports throughout the country. Project will aid airports and zoning authorities in planning new airports and noise abatement procedures.

▶ **Southern Airways** has purchased five Martin 404 aircraft, with financing from the issuance of $1 million in convertible debentures. Southern's long-term bank and supplier credit is nearly $2.3 million.

▶ **Trans-Texas Airways'** fare cuts of up to 32% between certain cities on its routes have been approved by Civil Aeronautics Board.

TACAN ACCURACY RIGHT OFF THE SHELF

HLI-119A
HLI-103B
HLD-129
HLD-141/144/146

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Preview
Showing
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Exhibit
Booth 1615

TACAN test equipment from the world's largest maker of airborne TACAN

Hoffman now offers a new and complete line of specialized test equipment necessary to maintain TACAN accuracy in the field—thus insuring the superior performance built into airborne TACAN equipment. Compact and rugged Hoffman simulators are available as standard off-the-shelf items (federal stock numbers assigned), and at lowest cost. Equipment tests all airborne TACAN models now in use.

HLI-119A (AN/ARM-25)
Radio Test Set

JANized portable unit radiates simulated ground beacon signal to check accuracy of **any** model TACAN (while operating in aircraft) for range, bearing and identification signals. Also checks power and sensitivity. Federal Stock No. 6625-724-8868.

HLI-103B
TACAN Beacon Simulator

Simulates functions of TACAN or DME surface beacons to enable maintenance men perform complete laboratory and bench tests on all model TACAN sets. Federal Stock No. 5625-668-4227.

HLD-129
Azimuth Error Analyzer

Detects and provides visual and recorded indication of static and dynamic tracking errors in azimuth portion of TACAN sets being checked by HLI-103B.

HLI-116A
Peak Power Calibrator

Measures peak output power of TACAN transmitter in kilowatts without use of calibration charts or auxiliary equipment.

HLD-141/144/146
Instrument & Power Panels

Simulates aircraft wiring in testing all AN/ARN-21 and ARN-65(V) TACAN sets and instruments removed from the aircraft. Federal Stock Nos. 6625-724-9938, 6625-448-7172, 6625-448-7177.

Send for complete data file on Hoffman TACAN test equipment and TACAN air navigational systems.

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Military Products Division

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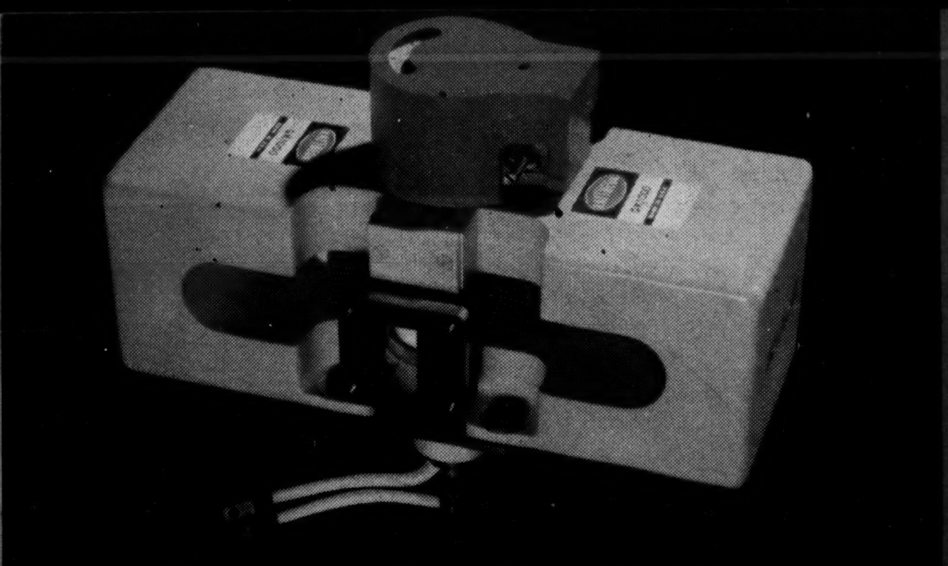
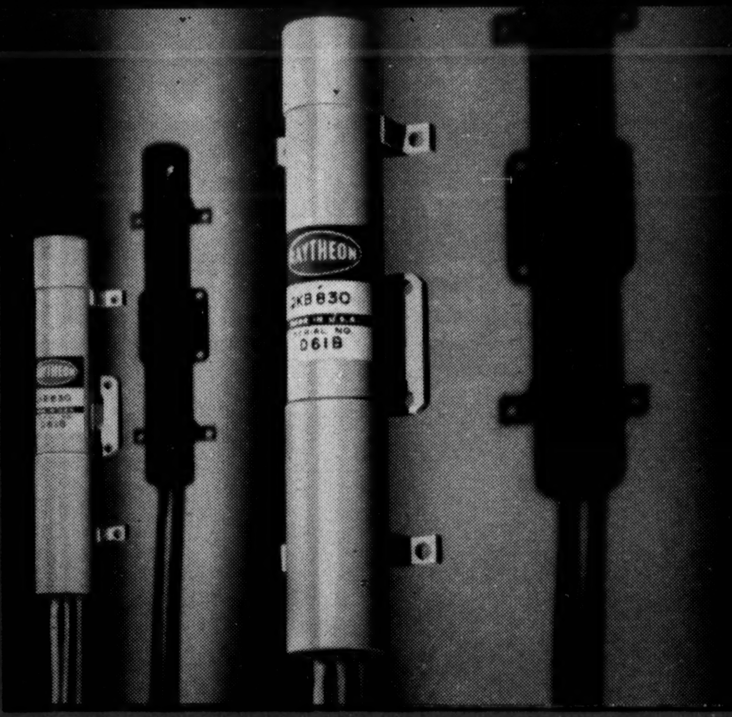
SIGNIFICANT DEVELOPMENTS AT HOFFMAN HAVE CREATED POSITIONS FOR SCIENTISTS AND ENGINEERS OF HIGH CALIBER, PLEASE ADDRESS INQUIRIES TO VICE PRESIDENT, INDUSTRIAL RELATIONS



ALL CERAMIC AND METAL X-BAND MAGNETRON provides 250 kW power at 8,500-9,600 Mc. Available in mechanically and hydraulically tuned models, QKH 1000 and QKH 1001.



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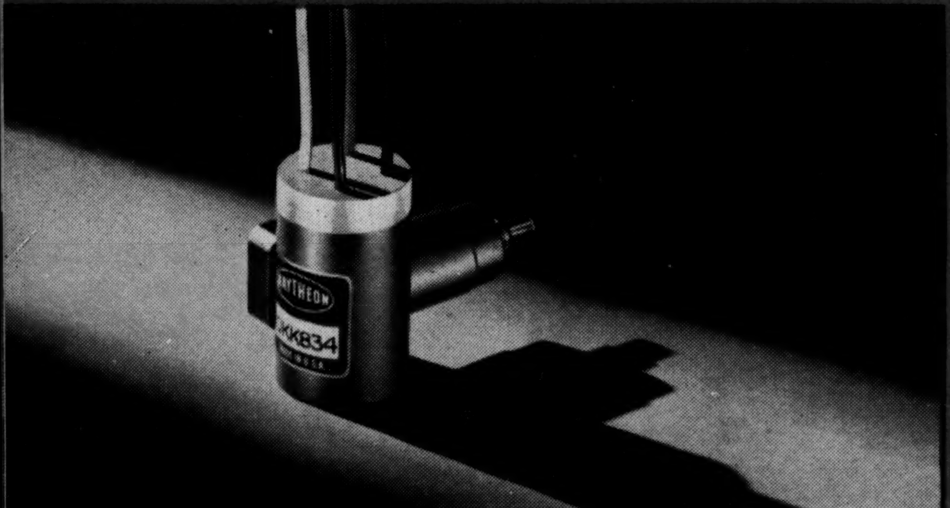
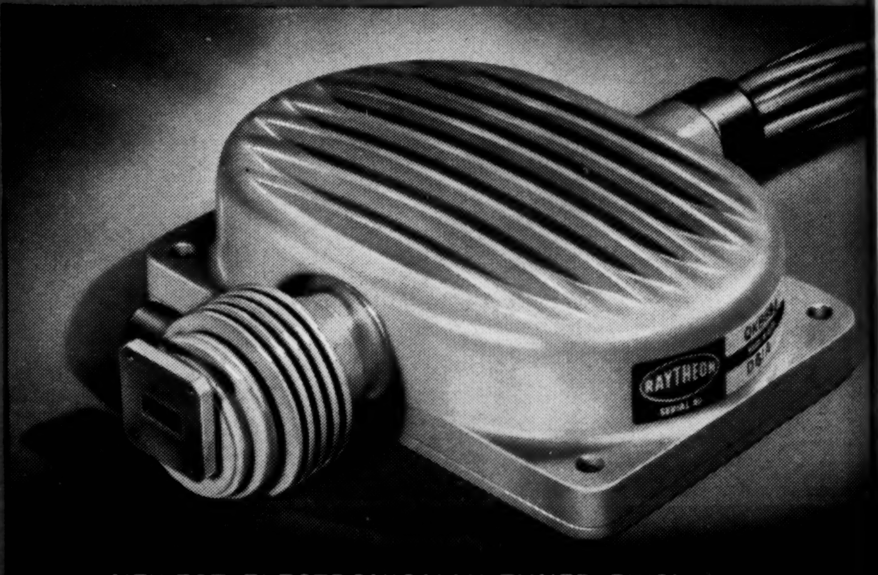


EXTREMELY RUGGED K-BAND KLYSTRONS have very low microphonics, excellent thermal stability. QKK 923 for 23.5-24.5 and QKK 834 for 34.0-35.6 kMc.



NEWEST ELECTRONICALLY TUNED BWO's have 40 mW minimum power output; are half the size and weight of their predecessors. QKB 890 for 12.4-18 and QKB 891 for 18-26.5 kMc.

6 MEGAWATT S-BAND MO A CHAIN

PHASE STABILITY AND HIGH EFFICIENCY are features of Raytheon designed high-power amplifier chains for sophisticated search and track radar applications. Chain shown is one example of Raytheon's ability to supply microwave tubes, ferrite devices and magnetic components in a completely integrated package.

OTHER RAYTHEON MICROWAVE TUBES TO BE FEATURED AT WESCON

- 100 kw coaxial L-band Amplitron* for phased arrays, QKS 1012
- Miniature ten-watt cw S-band Amplitron for space telemetry, QKS 997
- 2.5 kW three-cavity power amplifier klystron for cw radar, QKK 809
- Experimental X-band high-ambient-temperature magnetron, QR 933
- Reflex klystron that extends millimeter band coverage to 120 kMc, QKK 971
- Rugged miniature magnetron for missile beacon transponders, QKH 821

*Raytheon Trademark

RAYTHEON at WESCON puts emphasis on AEROSPACE MICROWAVE TUBES

Raytheon has been moving fast to break the bottleneck in the development and production of new microwave tubes for aerospace systems. WESCON engineers will see the evidence of this as a variety of new tubes for airborne, space and missile applications are introduced at WESCON.

Whether or not you plan to visit San Francisco, you'll want to skim the opposite page for tubes that will answer your aerospace systems needs . . . then let us know where to send the appropriate information bulletins.

See us at WESCON—Booth 3410-3412

WRITE TODAY, SPECIFYING TUBES that interest you, or tell us about your particular microwave problem. Address Microwave and Power Tube Division, Raytheon Company, Waltham 54, Massachusetts. In Canada: Waterloo, Ontario.

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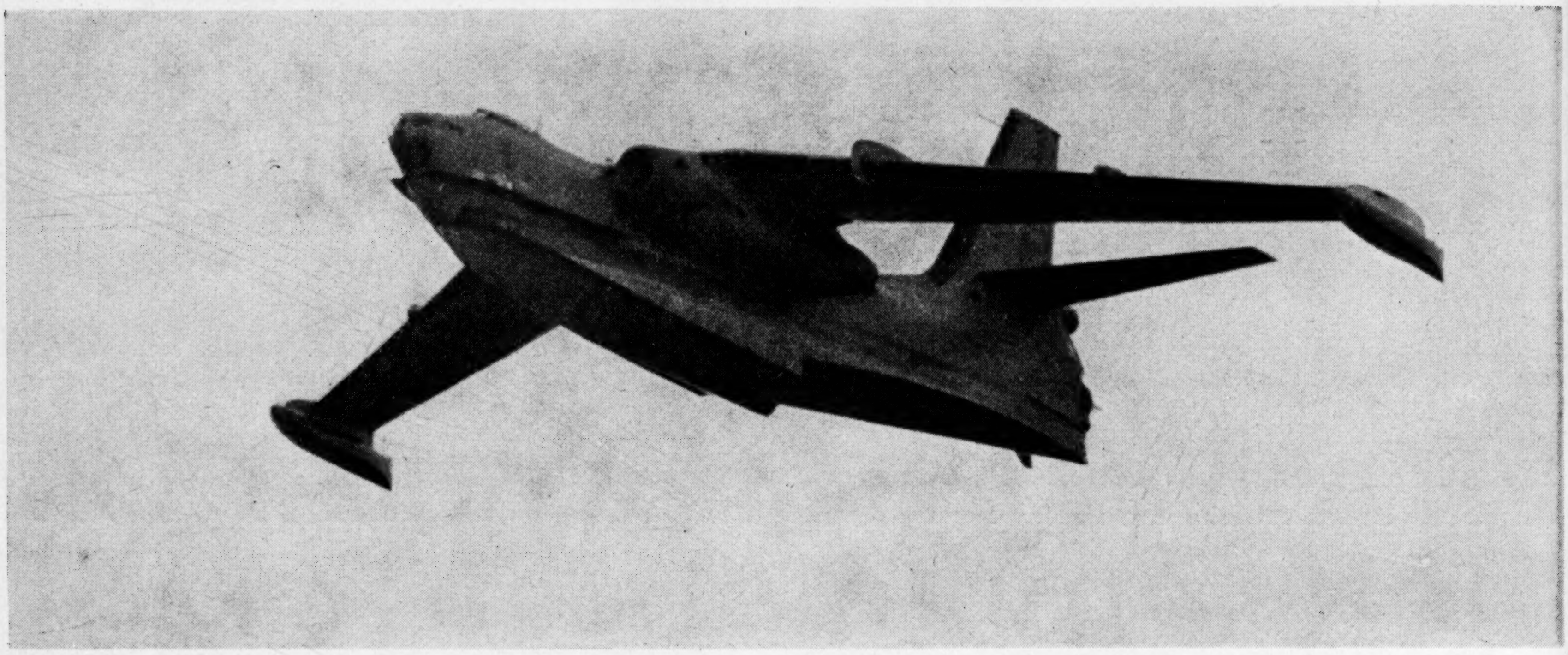
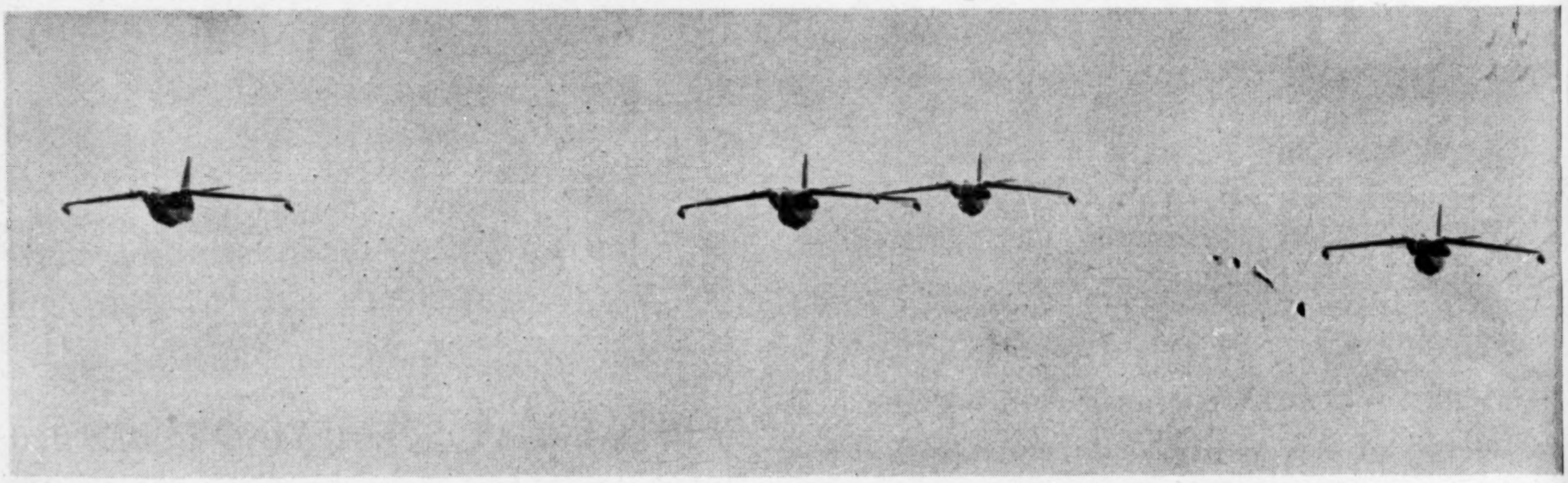
MICROWAVE AND POWER TUBE DIVISION

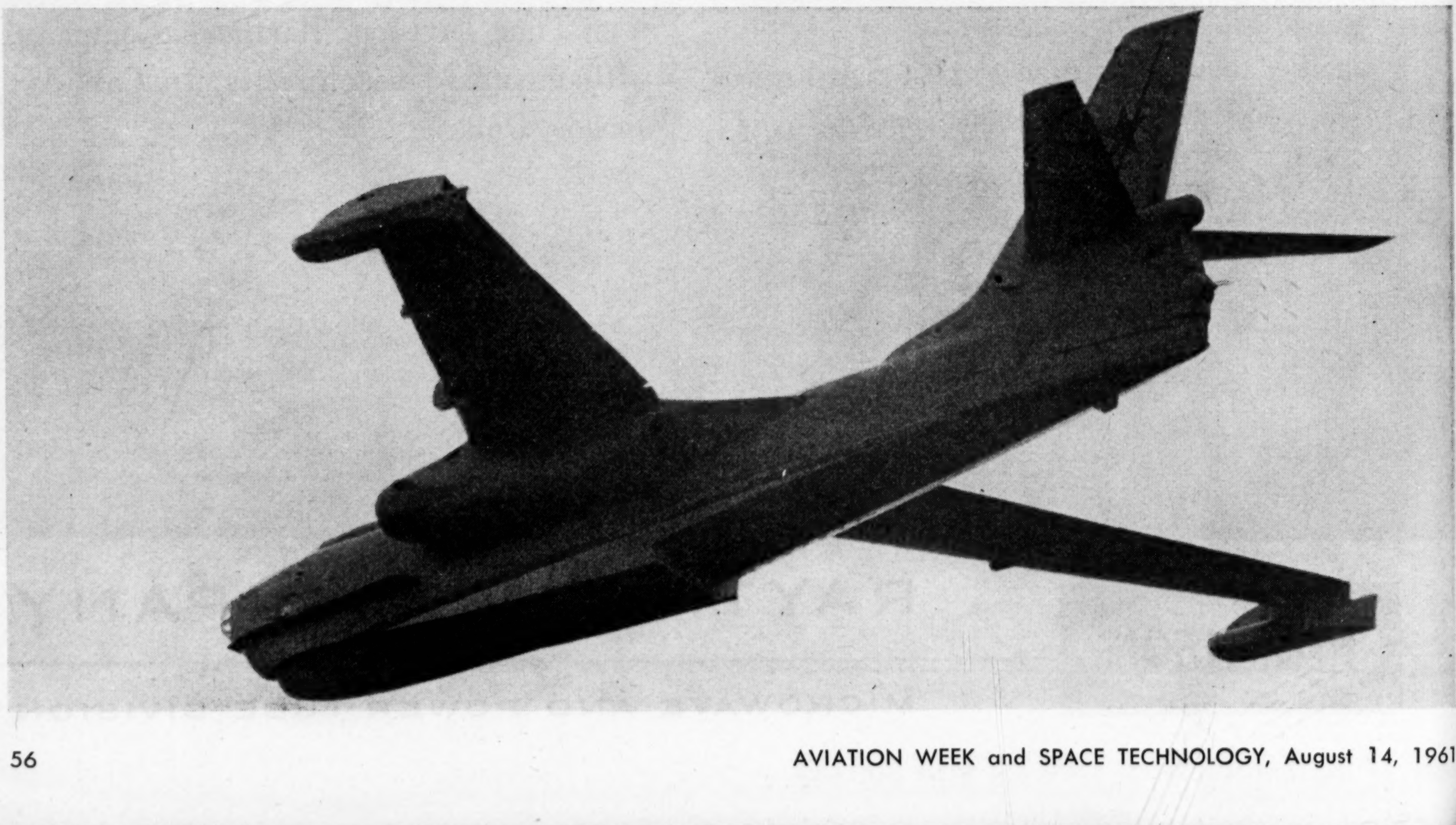


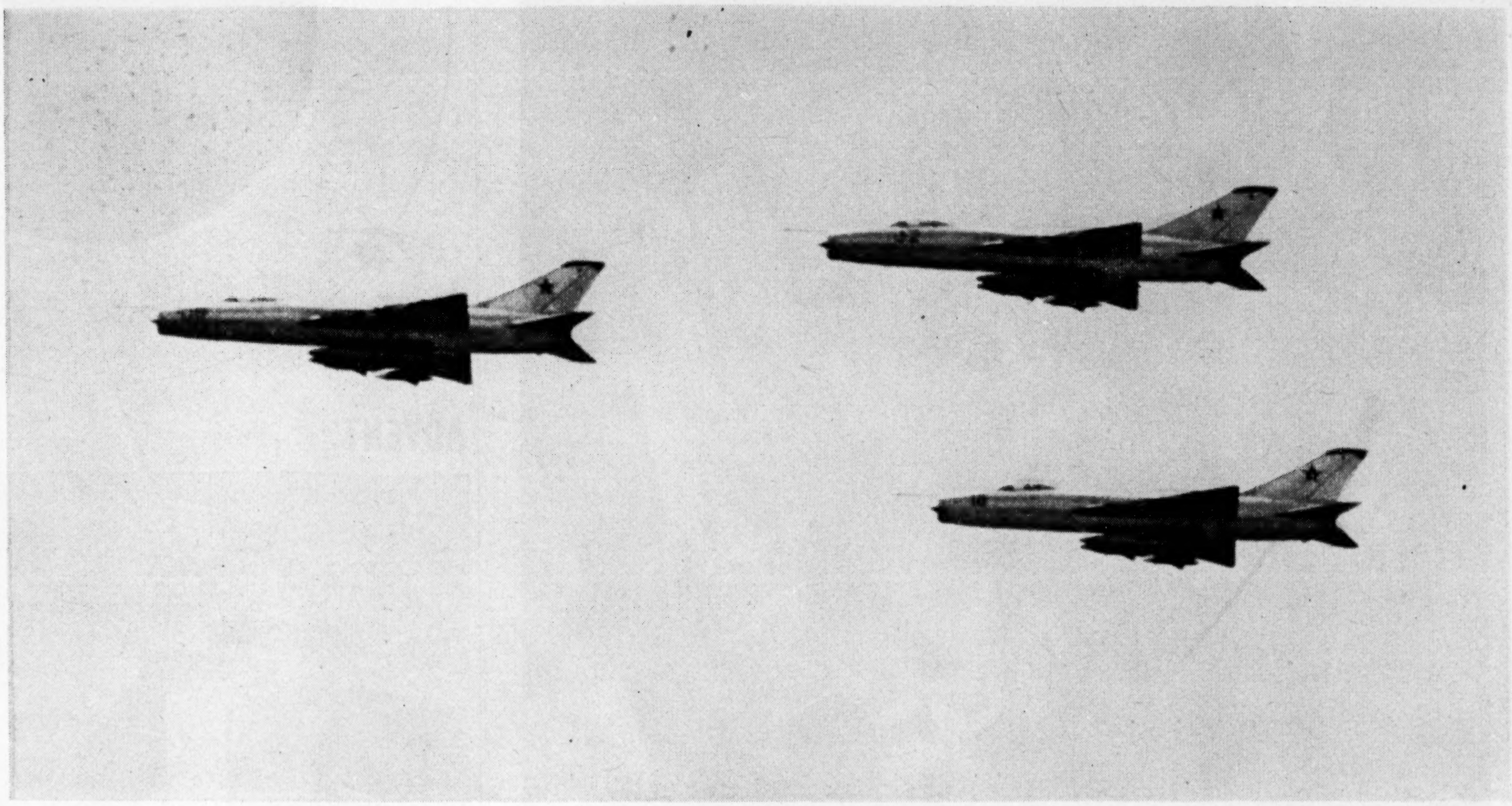
New pictures of Russian Beriev Be-8 jet seaplanes show additional hull details. Note width of bow strake designed to prevent spray ingestion by engines (AW July 17, p. 28). Seen in planform, the Be-8's engines are toed out from the fuselage at the rear.

Photos Show Added Russian Seaplane, Missile Details

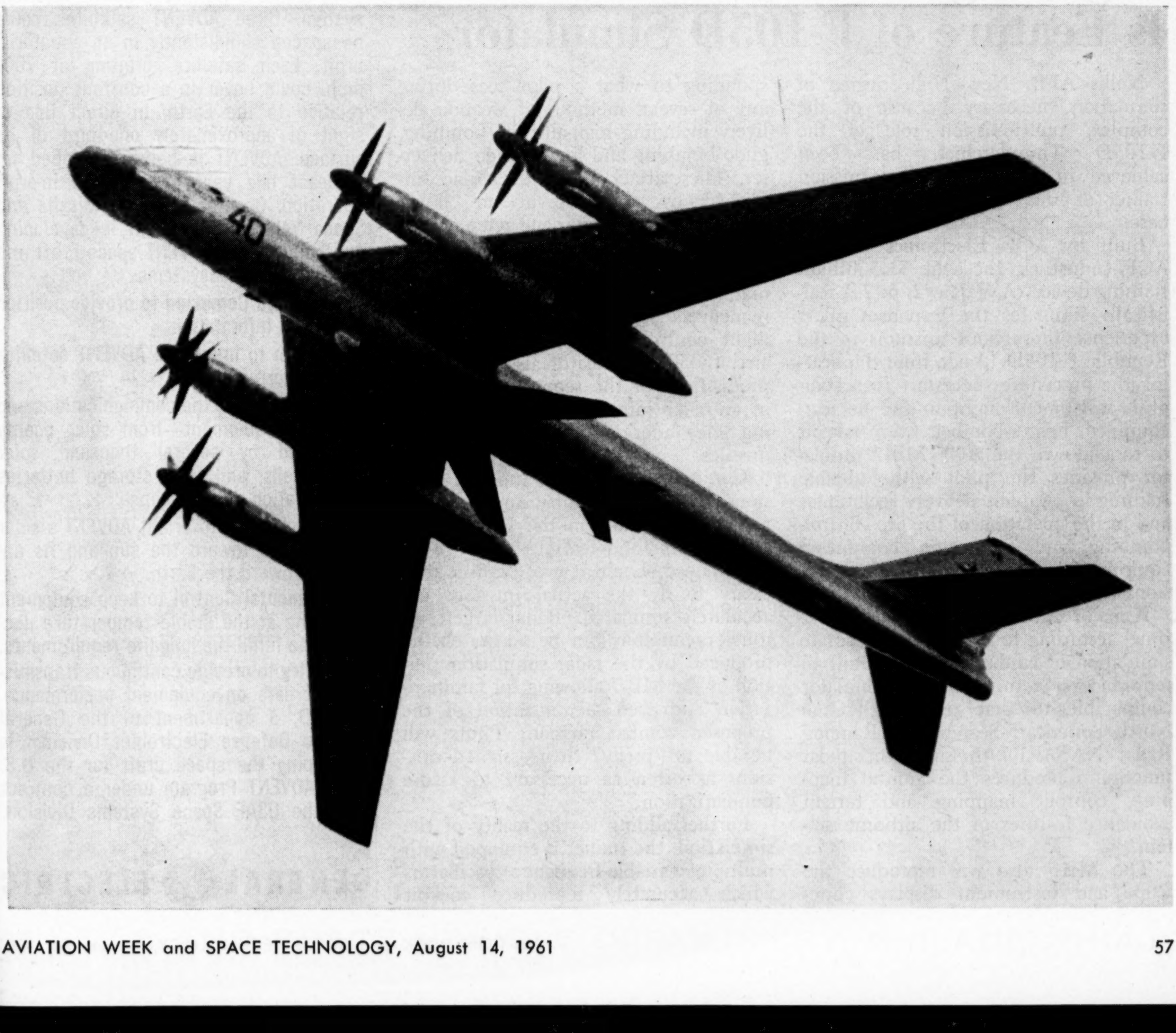


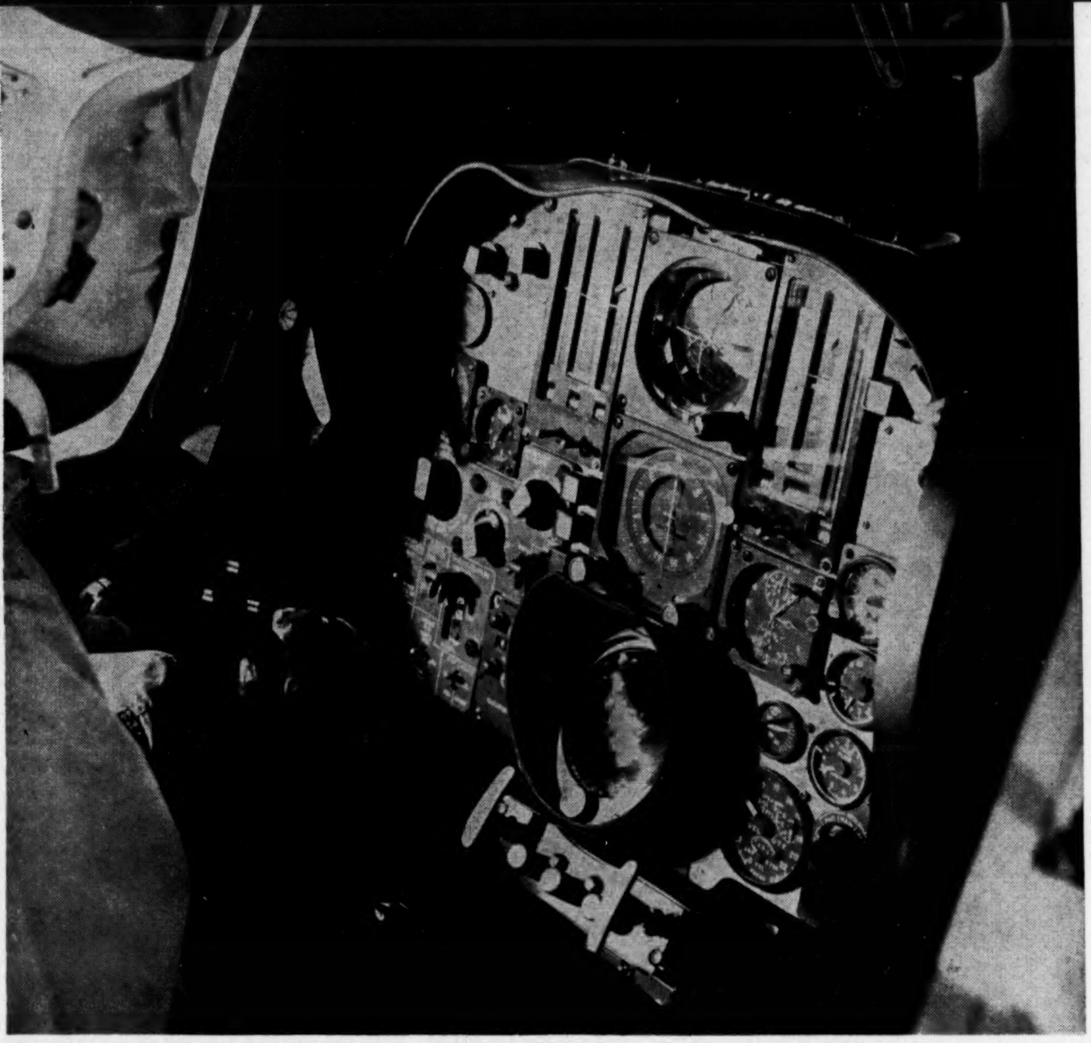
Be-8 has traditional Russian tail turret configuration. Forward fuselage shows signs of salt water damage to paint. Wings have negative dihedral, like the U. S. P6M, permitting wing tip floats to contact water without extension. Horizontal tail appears to have positive dihedral.





Russian Sukhoi Fishpot fighters (top) appear to be carrying yet another type of airborne missile (AW July 24, pp. 28, 29, 31). Silhouette shows a stubby configuration with small fins at nose and larger triangular fins aft. Planform of air-to-surface missile carried by Russian Bear bomber (below) is seen in this new photo showing highly swept wings. Small probes are visible at tips of tail surfaces. Nose of missile-carrying Bear is extensively modified for chin radome.





ACF INDUSTRIES' trainer for F-105D simulates pilot responses throughout missions.

High Degree of Mission Realism Is Feature of F-105D Simulator

Nellis AFB, Nev.—High degree of simulation, necessary because of the complex, multi-mission role of the F-105D Thunderchief, has been achieved in a newly-installed mission trainer at this combat crew training base.

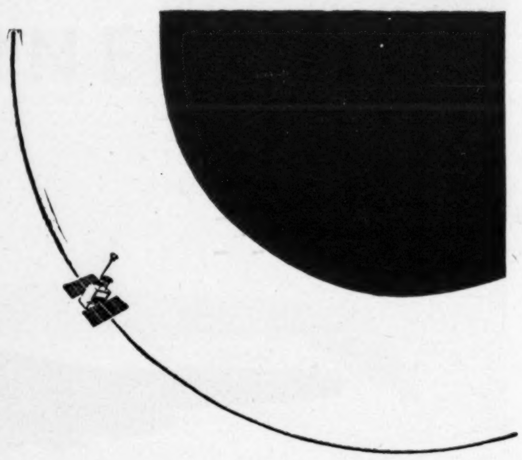
Built by ACF Electronics Div. of ACF Industries, Inc., the $1.3-million training device (AW Jan. 2, p. 74) realistically simulates the responses pilots experience throughout missions in the Republic F-105D. Aside from duplicating the procedures necessary to accomplish instrument flight in the nuclear-equipped fighter-bomber from takeoff to touchdown, the ACF MB-7 simulator provides the pilot with valuable training in weapons delivery techniques and in the operation of the fire control, bombing and navigation computing equipment carried for all-weather missions (AW Apr. 17, p. 88).

A major feature, achieved for the first time, according to ACF, is the accurate simulation of land-mass radar. Built to reproduce a return in the simulator comparable to that received by the North American Search and Ranging Radar (NASARR), the simulator's radar function reproduces the ground mapping, contour mapping and terrain avoidance features of the airborne system.

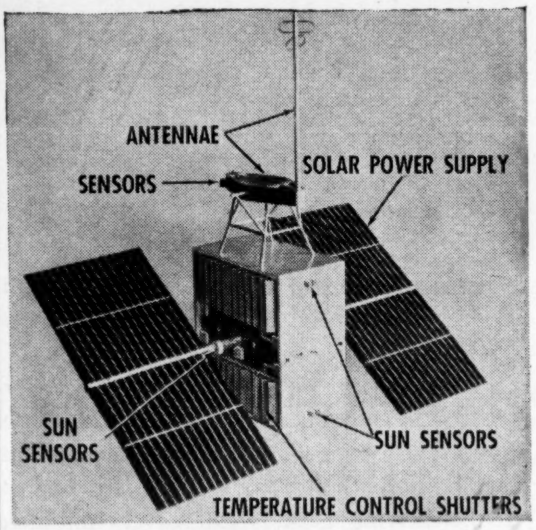
The MB-7 also will reproduce the scope and instrument displays corresponding to what a pilot sees during any of several methods of weapon delivery including high-altitude bombing, glide bombing and low-altitude deliveries. These attack maneuvers are accomplished by autopilot or are flown manually with instrument reference in the trainer just as it would be in the actual aircraft. Included are the automatic or instrument-directed escape maneuvers provided by the automatic flight control system (AFCS) in the aircraft. The simulator also affords reproductions of the scope presentations in air-to-air intercept missions employing Sidewinder or other current air-to-air missiles.

Complete profiles of wartime missions assigned to combat units can be preflown by pilots in the MB-7. The radar returns and features that will be experienced should it ever become necessary to fly the actual missions are accurately simulated. Radar target and route predictions can be accurately reproduced by the radar simulation portion of the MB-7 allowing for familiarization and even memorization of the proposed combat mission. Pilots will be able to "prefly" their assigned missions as often as necessary to assure familiarization.

Further adding to the reality of the simulation, the trainer is equipped with multiple variable-frequency oscillators which accurately reproduce cockpit



ADVENT



To create a worldwide communications system, three ADVENT satellites could be spaced equidistantly in an equatorial orbit. Each satellite, orbiting at 7000 mph, could hover in a constant position relative to the Earth, in direct line of sight of approximately one-third of its surface. ADVENT is being developed for at least one year of effective in-orbit operation. General Electric's Missile and Space Vehicle Department is developing and building the ADVENT space craft and the following subsystems:

Tracking and Command to provide position and orbit information.

Propulsion to inject the ADVENT satellite into its correct orbit.

Power to operate the communications and all other equipment—from solar energy harnessed by several thousand solar power cells; and from storage batteries for operation during eclipse.

Attitude Control to orient ADVENT's solar cell paddles toward the sun and its antennae toward the Earth.

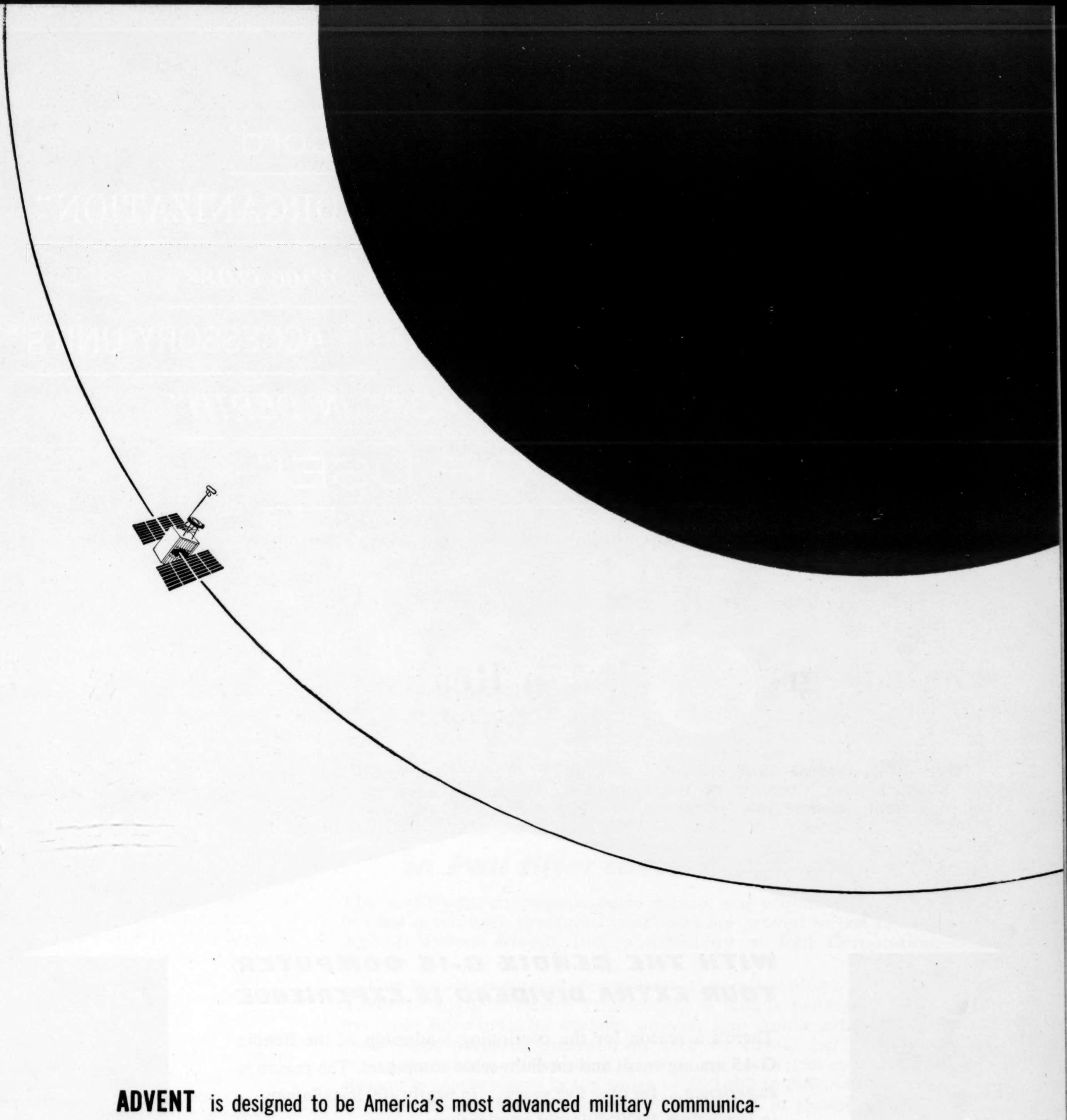
Environmental Control to keep equipment operating at the stable temperature necessary to fulfill the long-life requirements.

Telemetry to provide continuous transmission of data on equipment performance.

MSVD, a department of the General Electric Defense Electronics Division, is developing the space craft for the U.S. Army ADVENT Program under a contract with the USAF Space Systems Division.

160-02

GENERAL ELECTRIC



ADVENT is designed to be America's most advanced military communications system. Three active repeater satellites, orbiting at 22,300 miles in space, can provide instantaneous communications among U.S. government activities throughout the world. To help prove overall system feasibility, General Electric's Missile and Space Vehicle Department is developing the ADVENT space craft for the U.S. Army, under a contract with the U.S. Air Force.

GENERAL ELECTRIC

MISSILE AND SPACE VEHICLE DEPARTMENT, PHILADELPHIA, PA.

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"A VIGOROUS USERS EXCHANGE ORGANIZATION"

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"EASE OF USE!"

WITH THE BENDIX G-15 COMPUTER YOUR EXTRA DIVIDEND IS EXPERIENCE

There's a reason for the continuing leadership of the Bendix G-15 among small and medium-scale computers. The reason is *experience*... for over five years... in nearly 400 installations... in more than 1000 different applications.

Behind this experience is superior performance, real economy, and proven support... qualities which have made the G-15 preferred by thousands of engineers in industry after industry.

The G-15 achievement record is outstanding. It continues to be a leader in its field—the number of new G-15 users is growing every month. Investigate the proven capabilities of the G-15 today. See for yourself why G-15 "experience pays"... and how it can work for you. • *For information on your particular applications write to:*

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noises. In addition to engine and flight instruments, the trainer is equipped with oxygen and environmental systems. All possible manner of in-flight emergencies can be introduced to familiarize the pilot with systems operations.

In addition to the student pilot in the trainer, a rated pilot is used as an instructor to supply the problems. A technician is employed to assist the instructor pilot.

ACF is building seven of the MB-7 simulators for the Tactical Air Command. They will be installed at F-105D bases in the United States and abroad.

PRODUCTION BRIEFING

Atlantic Research Corp. has a $250,000 Air Force Flight Test Center contract for research in slurry fuels for ramjet and rocket engines. Company will work on liquid propellant systems containing liquid oxidizers and a metallic fuel to liberate heat, along with a third material that is gas forming.

Aerojet-General Corp. has signed a $6.3-million contract with the National Aeronautics and Space Administration for first-phase development of the Nerva nuclear rocket engine. Six-month contract also included a negotiated subcontract with the Westinghouse Electric Corp. for the nuclear portion of the project.

Bell HU-1B and commercial 47G-3B will be evaluated by the Army during high-altitude operations at Pikes Peak. HU-1B, which is being supplied to service units, recently underwent additional hot weather trials at Yuma, Ariz., and this together with Pikes Peak work will provide Army with additional technical data on performance under extreme conditions for better evaluation of field reports. Bell will provide the 47G-3B to demonstrate capabilities of this latest series of the light helicopter as off-the-shelf procurement. The company has completed deliveries of previous model 47 (H-13) series orders to the service.

Martin Co. received a $70.7-million Army contract recently to complete the Pershing test program and to begin production of the missile system.

Radiation, Inc., Melbourne, Fla., will supply PCM/FM ground telemetry equipment for combat crew training in the Air Force Minuteman program under a $700,000 subcontract from The Boeing Co.

Hercules Powder Co., Wilmington, Del., has received a contract exceeding $50 million from the Air Force Systems Command's Ballistic Systems Division for continued research and development

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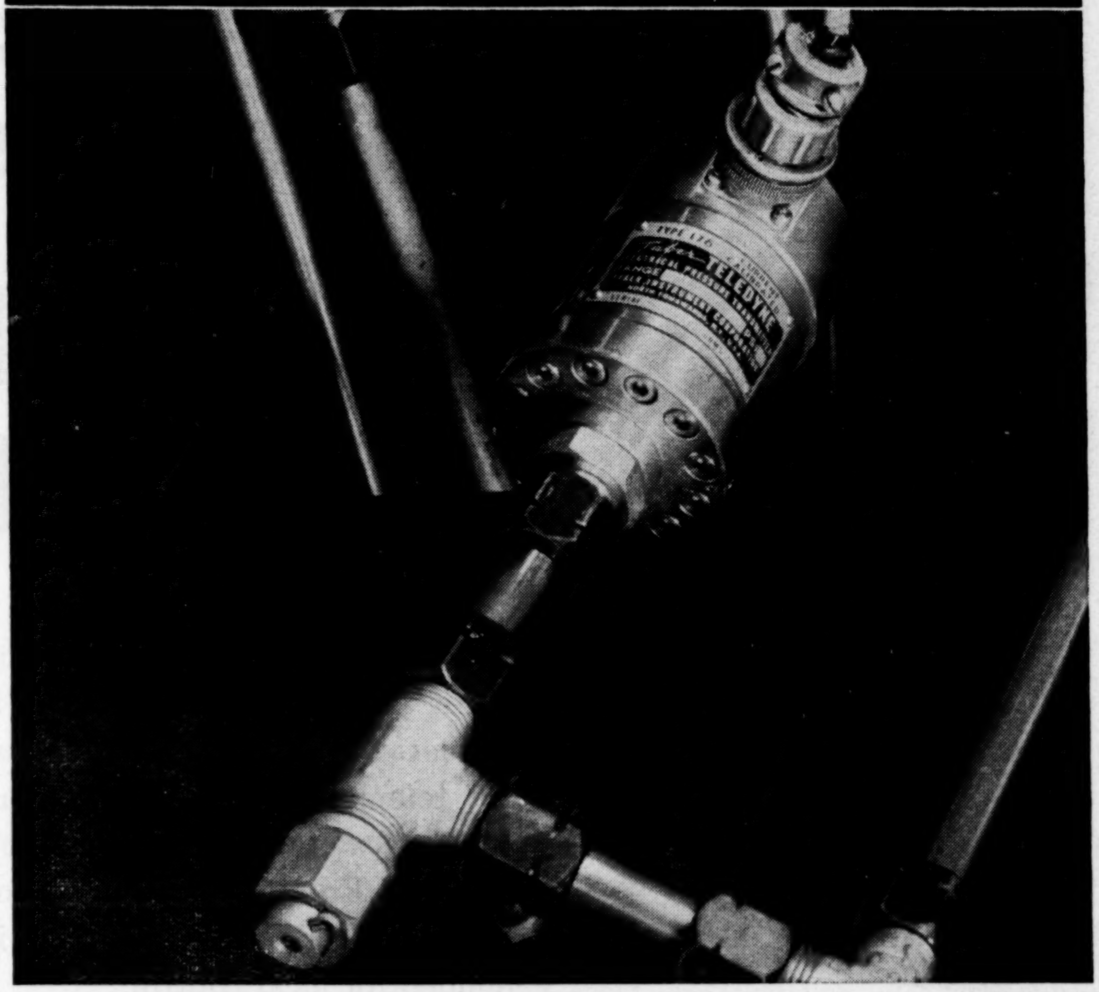
TELE·NEWS

ABOUT TELEDYNE AND TELEFLIGHT PRESSURE SYSTEMS



Taber Transducer logs 1,500,000 cycles in Pall filter tests without repair

The sensitivity, continuous performance and economical life of Taber bonded strain gage pressure transducers are proved in test operations at Aircraft Porous Media, Inc., a subsidiary of Pall Corporation, Glen Cove, N. Y.

This leading manufacturer of porous stainless filters uses Model 176 Taber Teledyne Pressure Transducers in fatigue testing pneumatic and hydraulic filter units for missiles, aircraft, and atomic submarines. During these tests, pressure pulses from zero to 10,000 psi are sensed and recorded on an oscilloscope at a rate in excess of 150 cycles per minute. Rate of pressure rise is in the range of 200,000 to 300,000 psi per second. The unit shown above has been in operation in excess of 1½ million cycles *without repair or overhaul.*

For full information on Taber Transducers (in pressure ranges from 0-50 to 0-10,000 psi) for test, ground support, and airborne applications, send this coupon attached to your letterhead.

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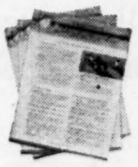
107 Goundry Street, North Tonawanda, N. Y.
Send detailed information on Taber Teledyne and Teleflight bonded strain gage pressure transducers.



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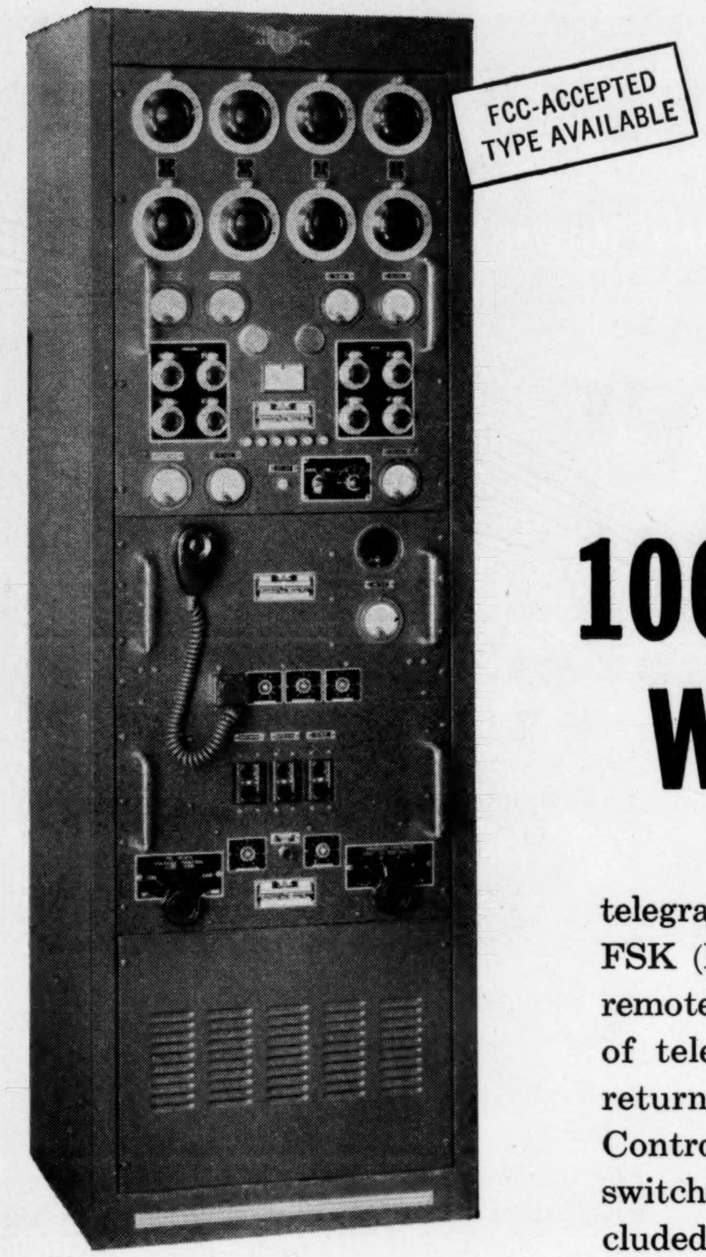

The world-famous

AEROCOM 1046 TRANSMITTER

1000 W CARRIER POWER WITH HIGH STABILITY

The Aerocom 1046 Transmitter is designed to give superior performance for all point-to-point and ground-to-air communications. It is now in use throughout the world in climates ranging from frigid to tropical (operates efficiently at −35° to +55° Centigrade).

As a general purpose High Frequency transmitter, the 1046 supplies 1000 watts of carrier power with high stability (above −10° Centigrade: ± .003% for telegraph and telephone. Temperature controlled oven for FSK). Multichannel operation is provided on telegraph A1, telephone A3 and FSK (Radio Teletype). It can be remotely controlled using one pair of telephone lines plus ground return with Aerocom Remote Control Equipment. Front panel switches and microphone are included for local control.

Four crystal-controlled frequencies (plus 2 closely-spaced frequencies) in the 2.0 - 24.0 megacycle range can be used one at a time, with channeling time only two seconds. Operates into either balanced or unbalanced loads. The power supply required is nominal 230 volts, 50 - 60 cycles, single phase.

The housing is a fully enclosed rack cabinet of welded steel, force-ventilated through electrostatic filter on rear door.

Telegraph keying (A1): Up to 100 words per minute. Model 1000 M Modulator (mounts in transmitter cabinet) is used for telephone transmission; a compression circuit permits the use of high average modulation without overmodulation. Model 400 4 Channel exciter is used for FSK.

Output connections consist of 4 insulated terminals (for Marconi antenna) and 4 coaxial fittings Type SO-239, which can be used separately or in parallel in any combination. For 600 ohm balanced load, Model TLM matching network is used, one for each transmitter channel.

As in all Aerocom products, the quality and workmanship of Model 1046 are of the highest. All components are conservatively rated. Replacement parts are always available for all Aerocom equipment.

Complete technical data on Aerocom Model 1046 available on request.

AER-O-COM

3090 S. W. 37th AVENUE MIAMI 33, FLORIDA work on the third stage propulsion unit for the solid-propellant Minuteman intercontinental ballistic missile. Contract also calls for delivery of flight test motors for the Minuteman R&D program at Cape Canaveral.

Boeing Co. and Catalytic Construction Co. are joint recipients of a contract from General Dynamics/Astronautics to install intercontinental ballistic missile aerospace ground equipment at Walker AFB, N. M. Boeing will manage the project, with Catalytic performing installation.

Chance Vought Corp.'s Structures and Systems Laboratory is engaged in the development of a photoelastic coating for studying stress factors on new heat resistant materials at temperatures exceeding 500F. Ten-month study contract was awarded by the Aeronautical Systems Division, USAF Systems Command.

Beech Aircraft Corp.'s Boulder (Colo.) Division has been awarded an $800,000 contract to build two types of semi-trailers for transporting Titan II fuel and oxidizer. Aeronautical Systems Division awarded the prototype contract.

Avco Corp. received a $4,450,000 contract from the Navy's Special Group for arming and fuzing of the Polaris missile.

General Electric's Ordnance Department has been awarded a $1-million contract to develop Naval Radio Research Station radio telescope aiming reference system.

Lear, Inc.'s Instrument Division, Grand Rapids, Mich., recently received an $8,112,000 contract from Navy's BuWeps for all-attitude indicating and low-altitude bombing systems.

Lear, Inc., Santa Monica, Calif., will install automatic flight control systems, including L-5H autopilots and command instrument systems, in New York Airways, Inc.'s new fleet of Boeing Vertol 107 25-passenger helicopters. System allows pilot to select altitude, course, or direct the 107 to hover over a position by pushing a button.

More than 100 General Electric J79-GE-5A turbojets for the General Dynamics/Forth Worth B-58A Hustler bomber are being modified to -5B configuration by Southwest Airmotive Co., Dallas, Tex., under a contract for approximately $400,000 from the U. S. Air Force. Contract marks the first work on the J79-type powerplant by the company.

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MAJOR BREAKTHROUGH in SYNCHRO RELIABILITY

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HAROSYN® the Brushless Synchro
Pat. Pending

- *2000-5000 Hrs. Operational Life Guarantee:* Life is limited only by ball bearings.
- *Eliminates Brushes:* Wear, brush bounce, electrical discontinuity and variable null voltages during shock and vibration, Radio Frequency Interference.
- *Eliminates Slip Rings:* Wear, surface film or oxidation which can cause arcing and brush burnout.
- *Interchangeable:* Mechanically and functionally with conventional synchros for almost all synchro applications.
- *Available:* In sizes 5, 8, 10 and 11 for the conventional Synchro functions.

HAROSYN features a rotary injection transformer in which the primary windings and the secondary windings are made a rigid integral part of the housing and rotor assemblies respectively. No mechanical contact whatever is made between rotor and stator. *Eliminates approximately 20 parts.* Meets and exceeds all applicable portions of MIL-S-20708.

See HAROSYN, the brushless synchro, at the Wescon Show, Booth 4510.

For further information write for Catalog 103.

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West Chester Pike at Westtown Road
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Motors: Servo, Synchronous, Stepper, Velocity Damped Magnetically Braked.
Motor Generators • Gearhead Units • Synchros • Servo Assemblies

UNSEEN BUT NEVER LOST. *Far down in the secret depths of the sea America's Polaris submarines can cruise for many weeks, poised for free world defense. Without surfacing, men of these submarines can pinpoint their exact position constantly. The equipment to perform this precise duty is called Mark II SINS (Ship's Inertial Navigation System). The first operational SINS was designed, built, and delivered in record time by Autonetics.*

Electromechanical Systems by **Autonetics** *Division of North American Aviation*

FIRST MK. 2 version of the English Electric Lightning jet fighter lands at Warton Airport, Lancashire, after its maiden flight.

Mk. 2 English Electric Lightning Production Under Way

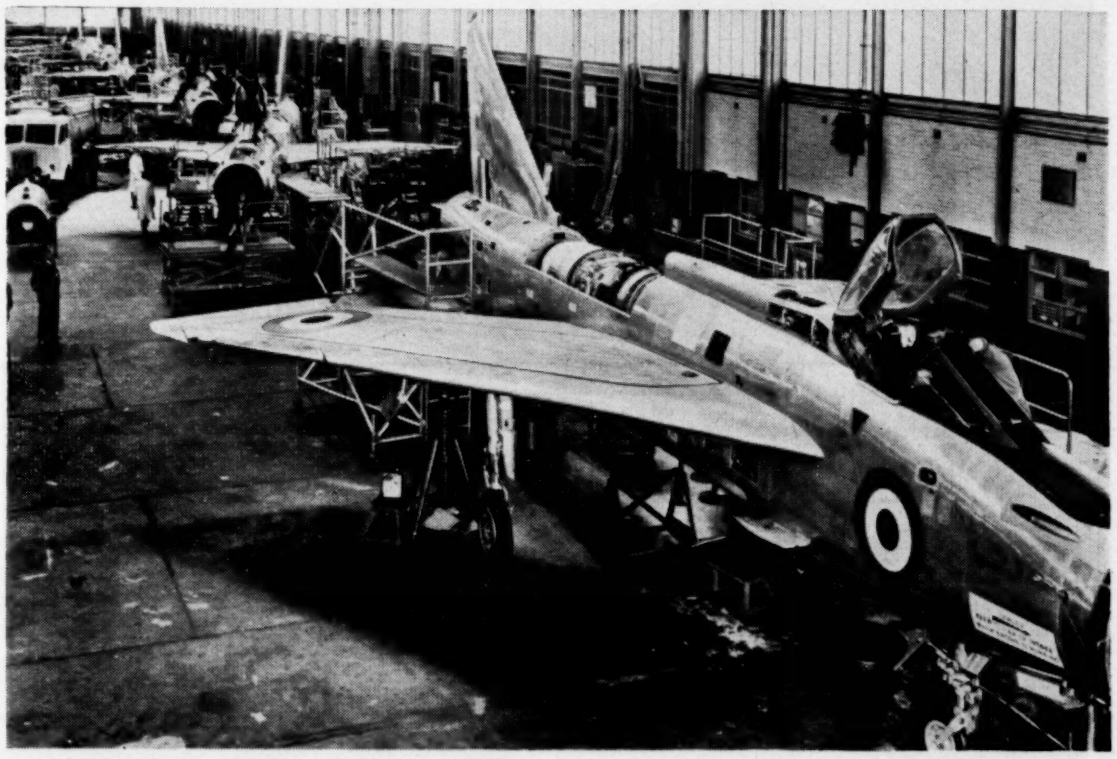
London—Production of Mk. 2 version of the English Electric Lightning jet fighter is now under way at the company's Warton, Lancashire, airport, along with the Mk. 4 two-seat trainer.

Mk. 2 Lightning changes are internal. Pilot's presentation has been modified, along with the weapons control system, but English Electric declines to discuss details. Engines probably are Rolls-Royce R.A.24R turbojets producing 14,300-lb. thrust with afterburning.

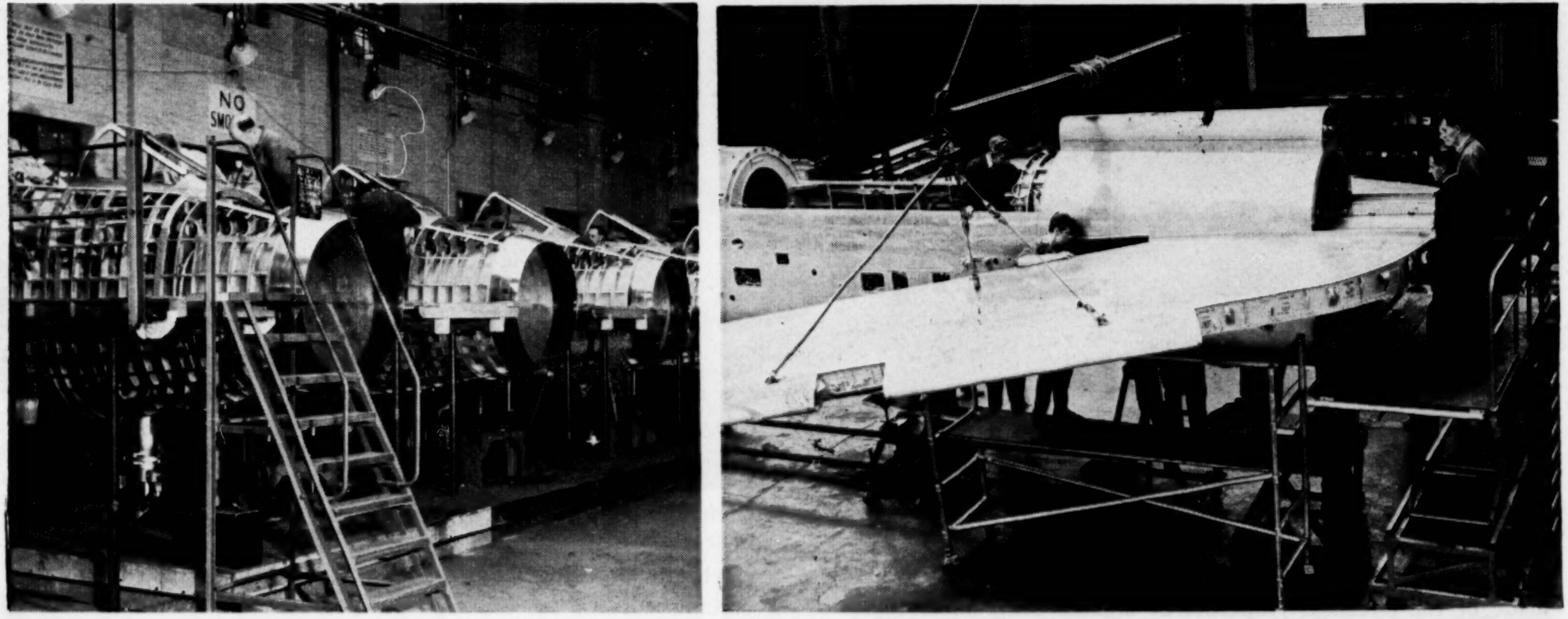
Still under development is the Mk. 3 version, which may have a higher powered Avon engine for faster climb to altitude, such as the Rolls RB.146 Series 300 which produces 18,000-lb. thrust with afterburning. Weapon for the Mk. 3 might possibly be the Red Top, an improvement on the de Havilland Firestreak it now carries.

Eleven Mk. 4 trainers, designated the Lightning P.11, have been built and most have been delivered to Royal Air Force. All marks include extensive use of titanium.

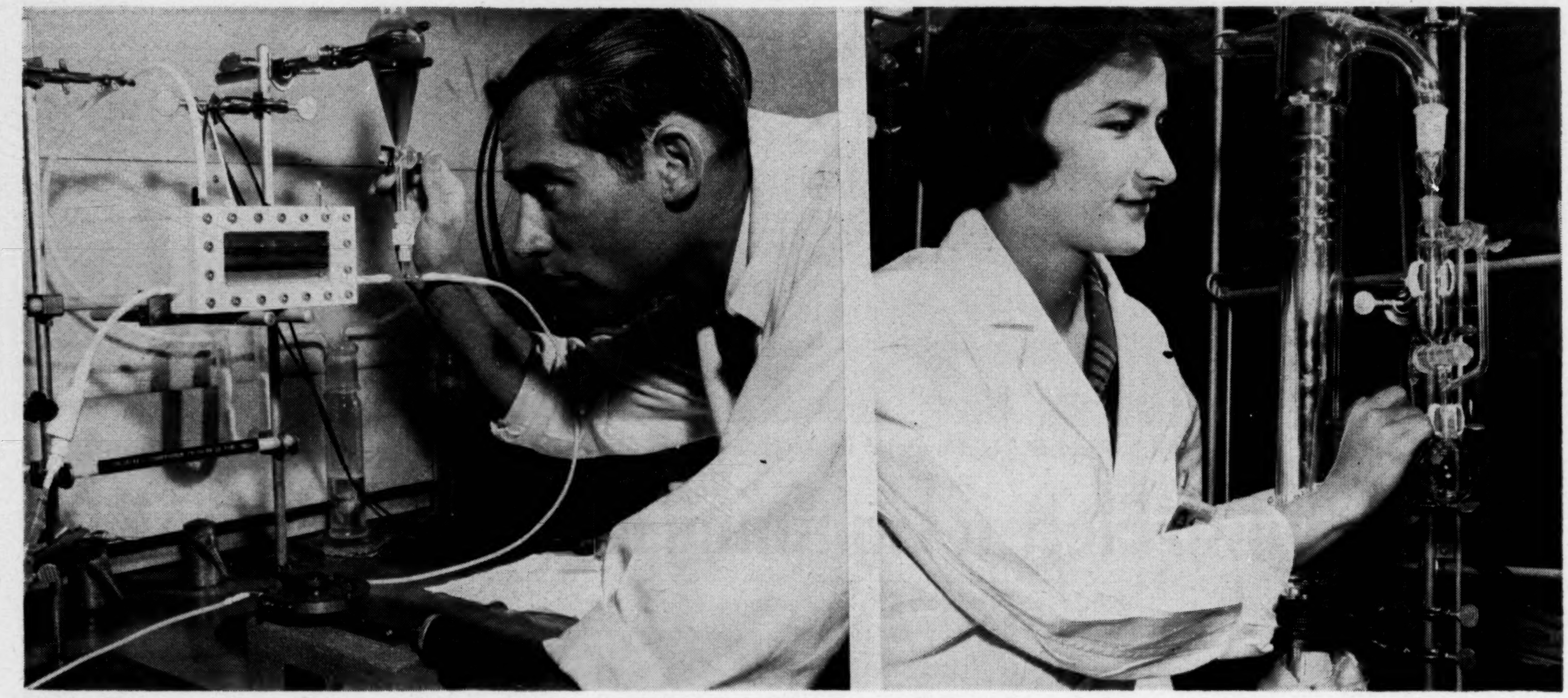
Since first flight of the Lightning preproduction trainer May 6, 1959, there has been only one major production change, an increase in fin size.



LIGHTNING PRODUCTION line at Warton shows placement of upper Rolls-Royce Avon turbojet engine with access plate removed. Ridge behind canopy contains circuit breakers, avionic gear and iso-propyl nitrate tank for starting. Stub below wing leading edge is mount for de Havilland Firestreak missile. Teardrop shaped structure seen in nose of second airplane is mount for Ferrari Airpass radar system.

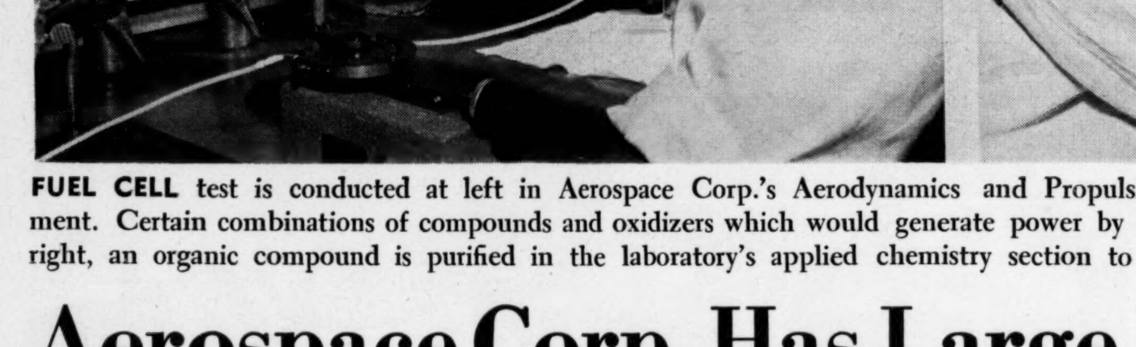


FORWARD FUSELAGE is shown under construction at left. Aft section of the Lightning's fuselage is mated to wing section at right.

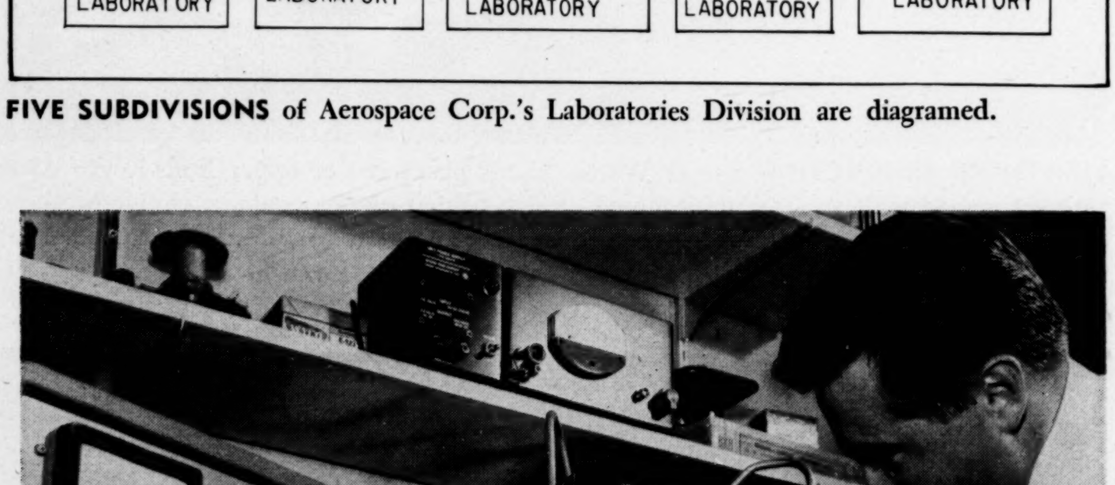


FUEL CELL test is conducted at left in Aerospace Corp.'s Aerodynamics and Propulsion Laboratory's Chemical Propulsion Department. Certain combinations of compounds and oxidizers which would generate power by electrochemical reaction are being studied. At right, an organic compound is purified in the laboratory's applied chemistry section to determine its electrical properties.

Aerospace Corp. Has Large Research Role


LABORATORIES DIVISION
PHYSICAL RESEARCH LABORATORY
ELECTRONICS LABORATORY
AERODYNAMICS & PROPULSION LABORATORY
MATERIALS SCIENCES LABORATORY
SPACE PHYSICS LABORATORY

FIVE SUBDIVISIONS of Aerospace Corp.'s Laboratories Division are diagramed.



ORGANIC COMPOUND is inserted in an oven at Aerospace Corp.'s Aerodynamics and Propulsion Laboratory's Chemical Propulsion Department to measure its electrical properties at varying temperatures. Test is part of a series of energy conversion research studies being made of the electrical properties of organic compounds that may be suitable for use in transistor solar cells or semiconductors.

By Irving Stone

This is the second article of a two-part series on Aerospace Corp. The first article (AW Aug. 7, p. 52) delineated the organization and responsibilities of the corporation and two of its three major divisions—Systems Research and Planning Division, and the Engineering Division. The third major division, the Laboratories Division, is described in this week's article.

Philosophy of conducting research was part of the original projection for Aerospace Corp. Its laboratory activity, which has not yet attained full momentum, is oriented toward basic and applied research in components and techniques directed toward achieving breakthroughs for systems which may apply 10 or more years in the future.

Approximately 50% of the Laboratories Division's effort essentially is in response to systems needs and Air Force requests. The remaining 50% is under control of Aerospace's staff, within approved areas.

Five departments within the Laboratories Division cover practically all the technical fields in space and missile systems except space biology, in which Aerospace has no active programs or plans for any at this time. Air Force has extensive programs under way in this field and NASA also will play a big role in this area of investigation. If the need should arise, Aerospace is prepared to expand into space biology.

Laboratories Division also serves as a collection source for the Air Force for basic and applied research from industry. In this capacity it acts as a clearing house to advise the Air Force of the direction research is taking and the relative successes and competences of various industry groups. Because Aerospace is non-profit, it has relatively free access to this industry information. Industry also comes to it voluntarily with research information to promote Air Force interests.

Most of the Laboratories Division's work is unclassified and there is free exchange with all qualified scientific groups on Aerospace's laboratory programs. Information on programs which are classified is available to those having a need to know and doing work in the specific or a related field.

One of the activities to which all divisions in Aerospace contribute, but which gets the most emphasis in the Laboratories Division, is Applied Research Management. In this activity Aerospace assists the Air Force technically in the management of industry and university contracts in applied research. It advises the Air Force on progress of the work and phases which look promising. Roughly $100 million of applied research has emanated from Ballistic Systems Division/Space Systems Division funds. Contracts in this category number in the hundreds.

The broad effort of the Laboratories Division—covering practically the entire spectrum of basic and applied research—is divided among the following:

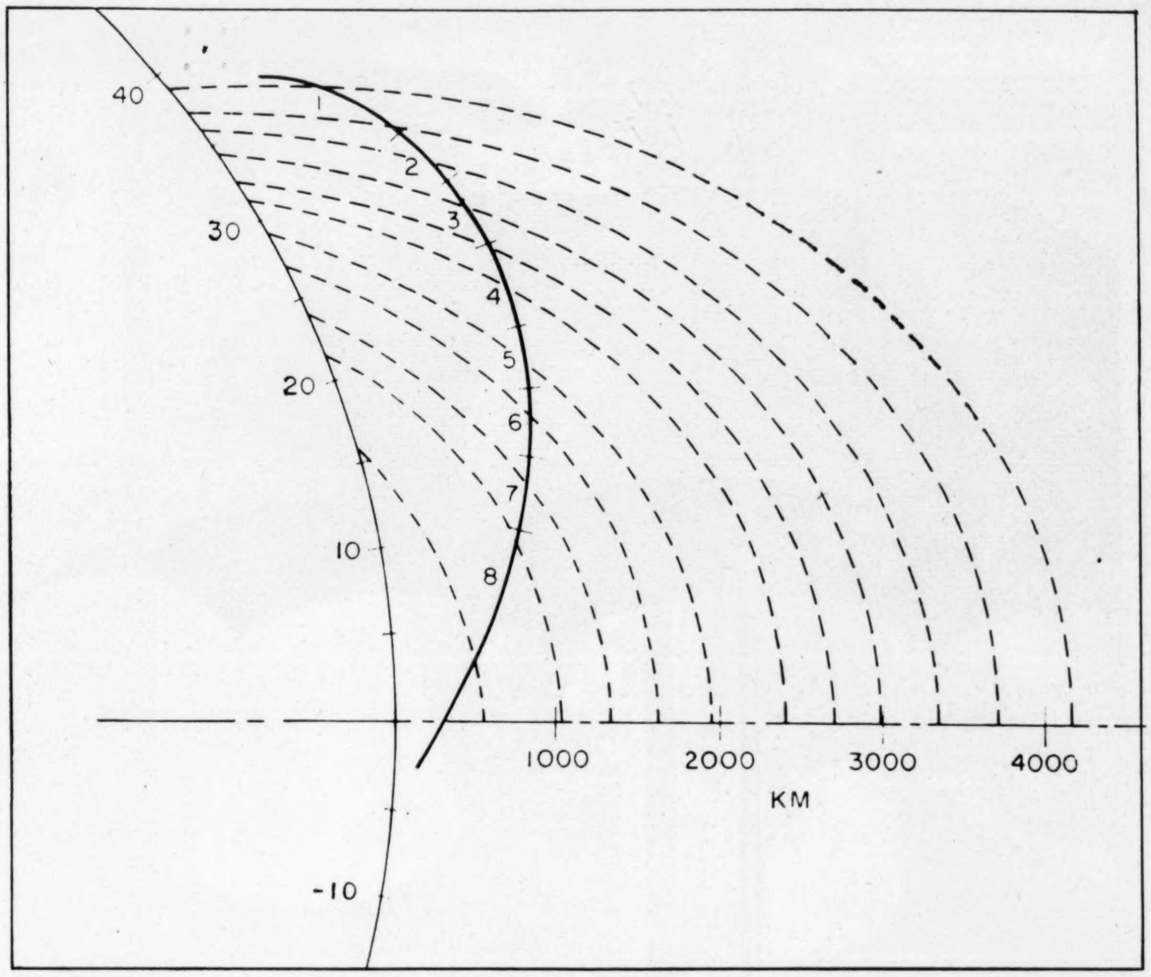
- **Physical Research Laboratory.** This activity had considerable momentum when it began operation, because about half of the members of the technical staff here transferred from Space Technology Laboratories' similar activity.

The basic aim is to conduct long-range research for the development of new physical concepts for Air Force far-ahead programs. This involves a broad capability involving theoretical and experimental personnel for work areas embracing physics, chemistry, fluid dynamics, and related areas.

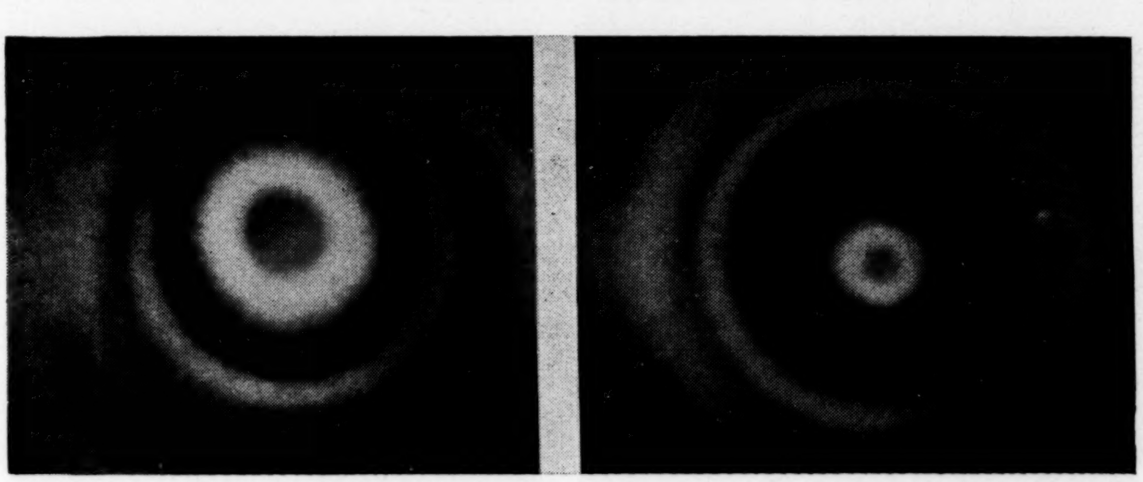
The laboratory is heavily involved in the study of magnetohydrodynamics as it relates to controlled fusion, since this might be the means of energy sources or propulsion a decade from now.

Magnetohydrodynamic studies also are being performed in plasma propulsion and in re-entry control, possibly by varying the thickness of the shock pattern on one side of re-entry body.

Communication techniques through ionized gases are being investigated, since difficulty may be experienced here during the re-entry phase. One experiment being flown on an Atlas missile is to measure the conductivity of the hot gases around the entering nose cone. Another area of research suggested by



GRAPH showing relationship of Atlas ICBM flight trajectory in October, 1960, to geomagnetic field, in nuclear emulsion experiment conducted jointly by Aerospace's Space Physics Laboratory and Lawrence Radiation Laboratory to measure spectrum of trapped protons in inner radiation belt. Left curve represents earth's surface with degrees of geomagnetic latitudes. Heavy curve is Atlas trajectory divided into altitude zones. Dotted lines are magnetic lines of force at various distances from earth. Work is being conducted to obtain flux and energy spectrum in each of the altitude intervals shown on the trajectory.



KERR CELL photographs of transverse pinch experiment in Physical Research Laboratory using preheated and pre-ionized deuterium plasma compressed by rapidly rising longitudinal magnetic field produced by 250,000 amp. flowing in 10-cm.-dia. single-turn strap around plasma vessel. Photos show successive configurations (top left, top right, bottom left, bottom right) during alternate contraction and expansion of plasma column, with eventual development of instabilities. Interval between configurations is about 0.4 microseconds.

FLYING COVER

From a distant ASW destroyer flies DASH*—an unmanned helicopter, observed from the ship by radar. Its mission—to deliver its weapon against an enemy submarine. Drone master control from the destroyer controls 'copter direction, altitude and weapon release. The shipboard and airborne radio control link is a product from Babcock, the world's leading designer and manufacturer of remote control and guidance systems.

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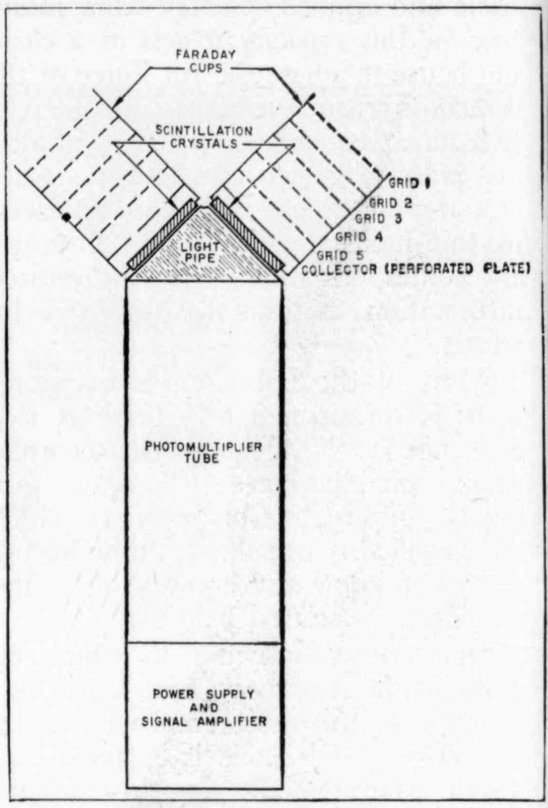


FARADAY CUP SYSTEM being designed in Aerospace's Space Physics Laboratory to measure the flux and spectrum of electrons and ions in energy interval of 1 to 50 kw.

this effort is the technique for varying this conductivity.

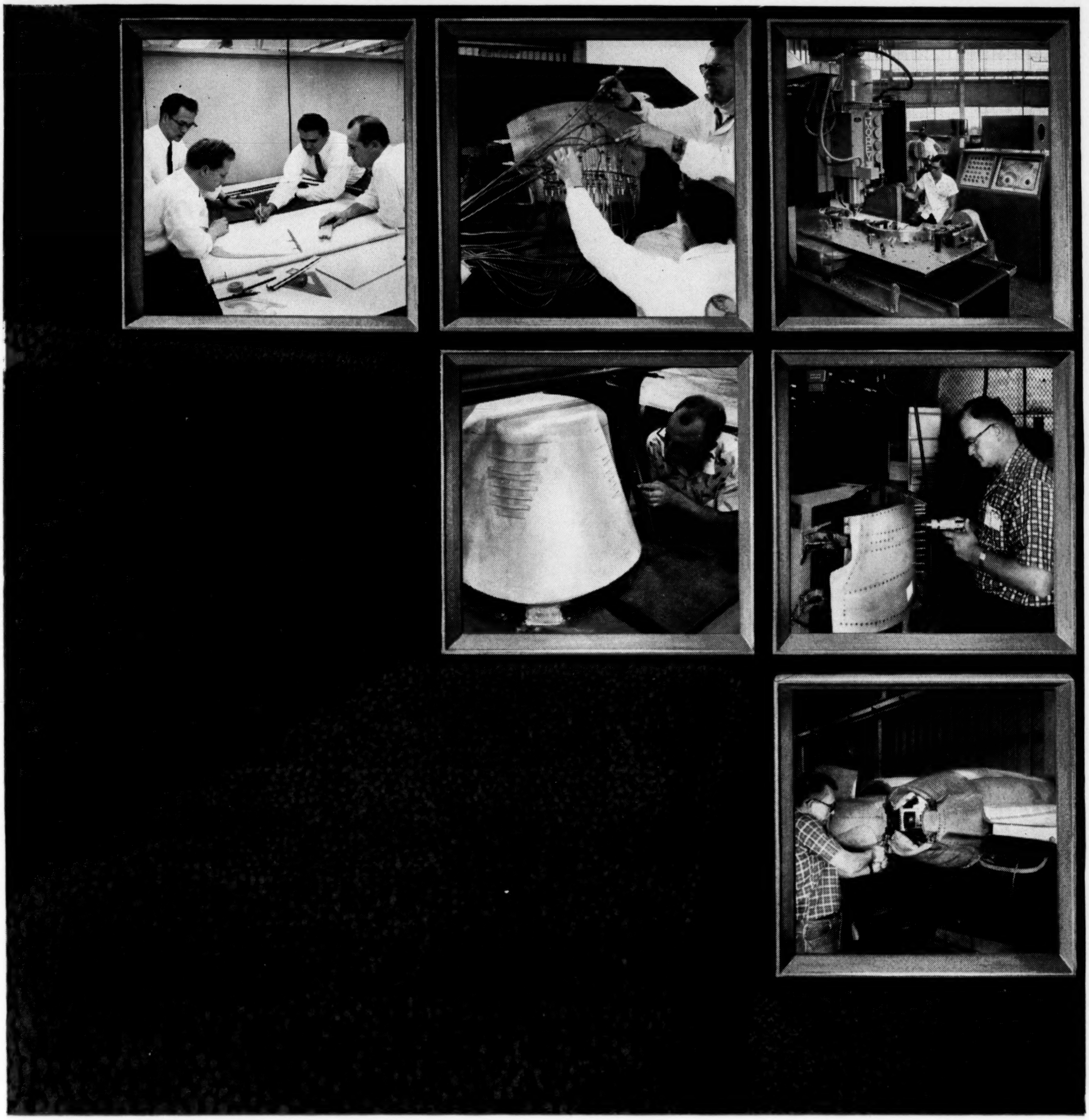
The laboratory is following the Air Force/General Atomics Project Orion to ensure that it is supported properly and that the research is properly oriented.

The program has long-range propulsion potential, through controlled atomic explosions.

Theoretical studies are being pushed in fluid mechanics, plasma physics and superconductivity. This last category indicates potential in the creation of strong magnetic fields for plasma propulsion, and may be useful in connection with fusion research.

Approximately 25 members of the technical staff are employed in the Physical Research Laboratory.

- **Space Physics Laboratory.** This activity is divided into three departments—Space Particles, Upper Atmosphere and Quantum Physics. Only the space particles effort has been implemented and includes the study of solar particles, radiation belts, magnetic and electrical fields in space, and lunar analysis. Emphasis will be placed on lunar planetary surface studies later in the program. The laboratory is cooperating with UCLA's Lawrence Radiation Laboratories for the use of neutron bombardment to make a rough analysis of lunar surface composition. Neutrons will make surface material emit gamma rays, the specific rays being emitted depending on the specific material. Neutron pulses will be supplied by a small generator. The experiment is being proposed to NASA, and may be carried on one of the Surveyor soft-landing



Every step of the way through ENGINEERING, TOOLING, MANUFACTURING Rohr provides a world of experience and capability in aerospace structures. Typical is the jet pod and thrust reverser program shown above. Rohr engineers developed design concepts, coordinating with customer design groups, then worked closely with Rohr research, tooling, testing and production people in all phases of manufacture. Result? Specifications met on time at minimum cost!

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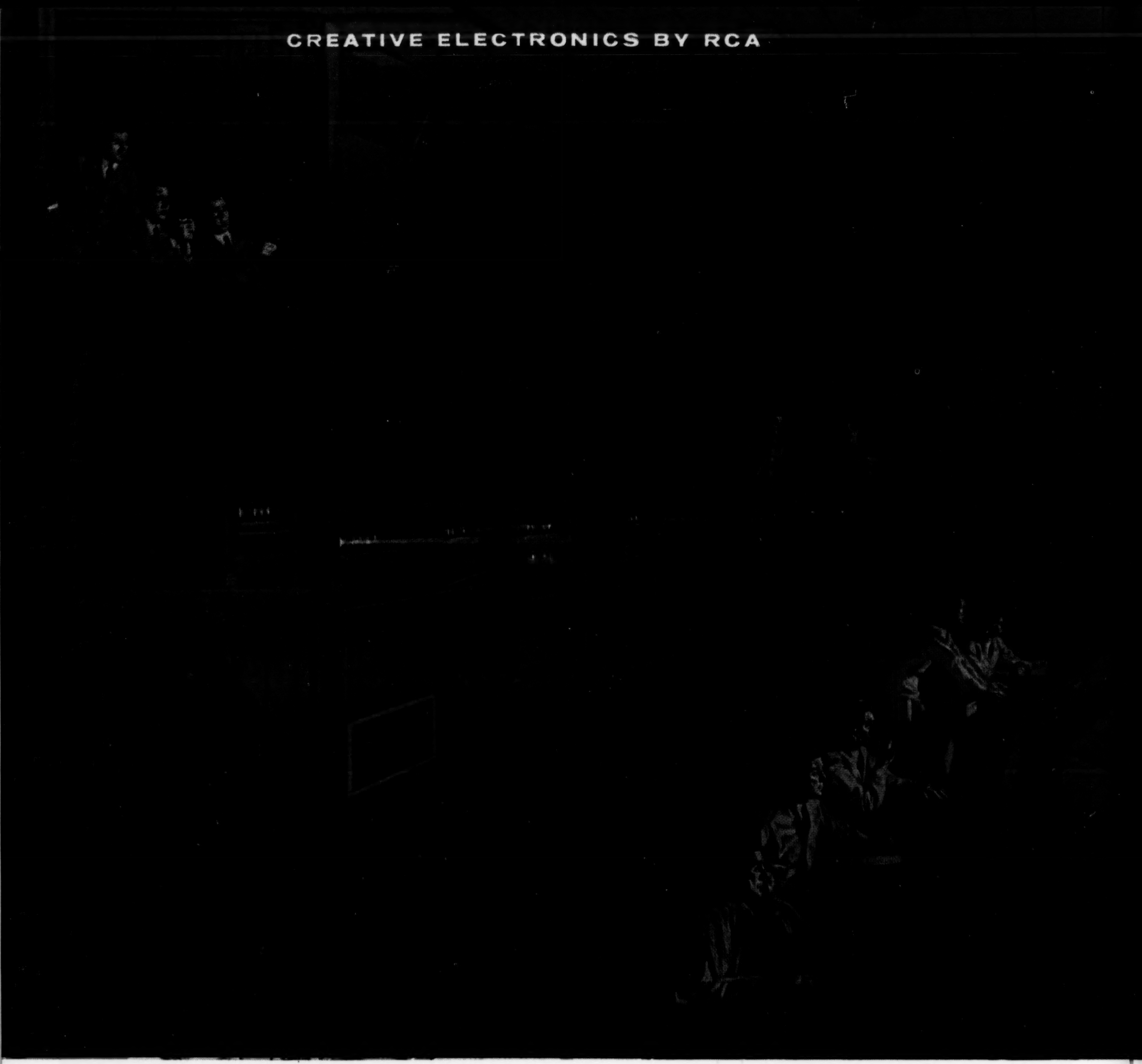


CREATIVE ELECTRONICS BY RCA

NORAD ON THE ALERT

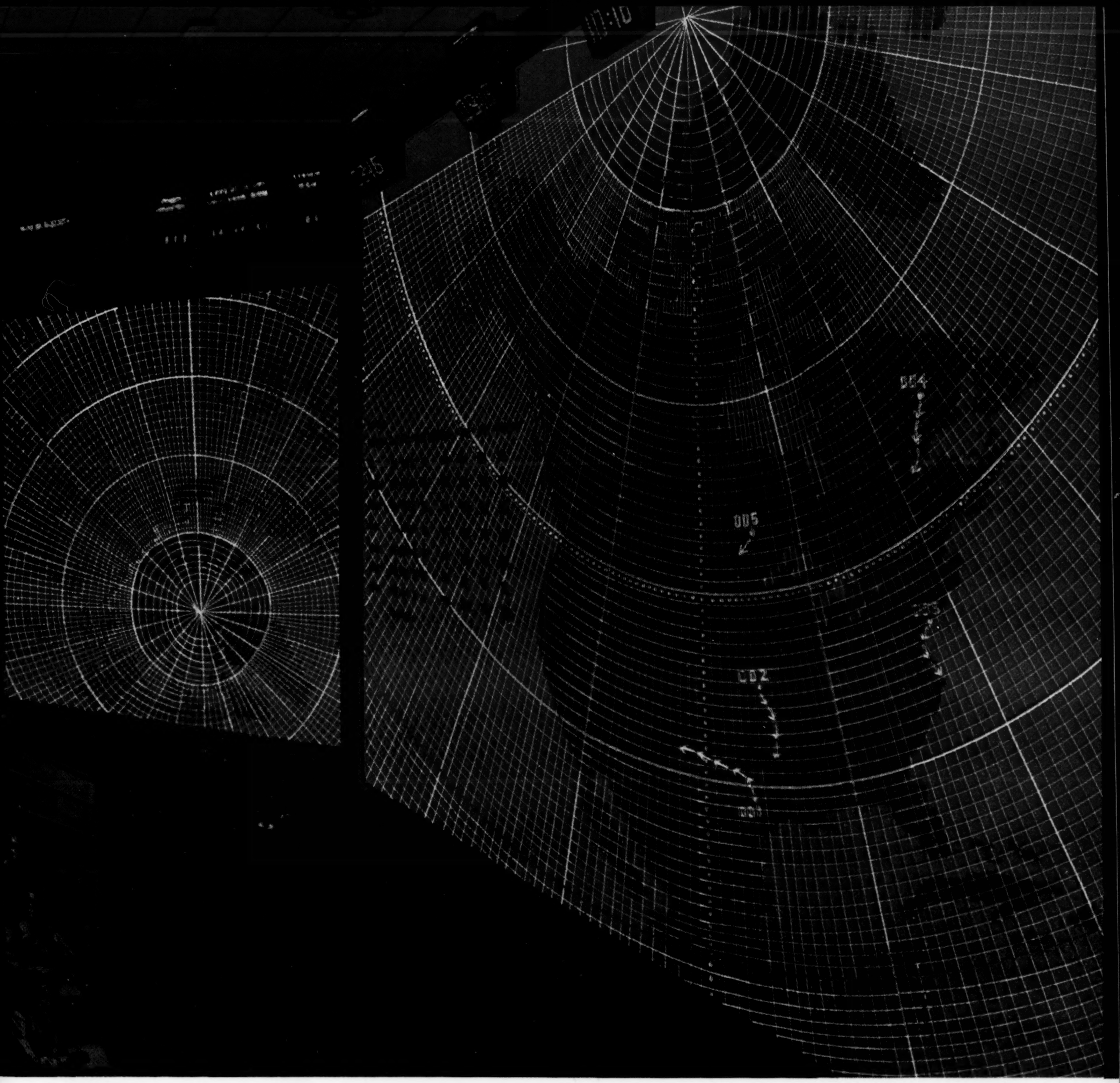
Inputs from BMEWS Provide Instantaneous Missile Data Direct to NORAD Headquarters

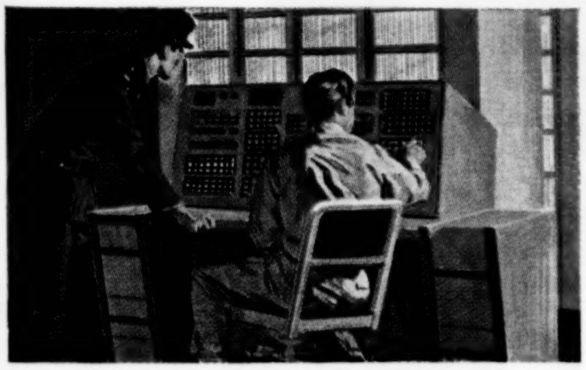
From our vast outer defense perimeter, over thousands of miles, to the nerve center of the North American Air Defense Command at Colorado Springs, the most advanced concept of data handling and checkout is being utilized in the BMEWS system. The stakes are high, for the purpose is defense of the North American Continent.

At BMEWS installations operated by USAF Air Defense Command, computers read out missile tracking data from giant radars. This information is simultaneously relayed to NORAD's Combat Operations Center.

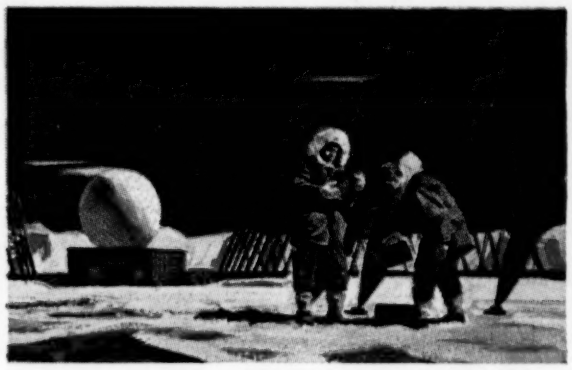
The Radio Corporation of America is prime systems contractor for BMEWS. At the COC, RCA's Display Information Processor computing equipment automatically evaluates missile sightings, launch sites and target areas. By means of data processing and projection equipment installed by RCA and a team of other electronics manufacturers, the findings are displayed on huge, two-story high map-screens in coded color symbols, providing the NORAD battle staff with an electronic panorama of the North American and Eurasian land masses.

The handling of BMEWS inputs at NORAD is an example of how RCA data processing capabilities are assuring the high degree of reliability so vital to continental defense.

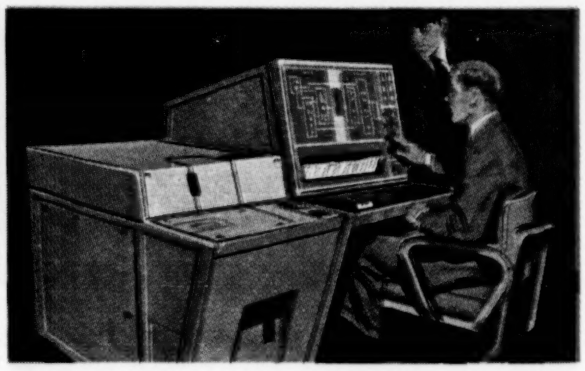




At NORAD Headquarters, RCA computing equipment, the Display Information Processor (control console shown here) receives sightings data from BMEWS and processes it for automatic readout.



RCA is prime system contractor for the sprawling BMEWS three-site radar network whose probing electronic fingers reach deep into space to provide early warning of missile attacks.



RCA's Automatic Checkout & Monitoring equipment continuously tests and checks performance of portions of the system and alerts an operator when a monitored signal exceeds certain limits.

Out of the defense needs of today a new generation of RCA electronic data processing equipments has been born. For tomorrow's needs RCA offers one of the nation's foremost capabilities in research, design, development and production of data processing equipment for space and missile projects. For information on these and other new RCA scientific developments, write Dept. 434, **Defense Electronic Products,** Radio Corporation of America, Camden, N. J.

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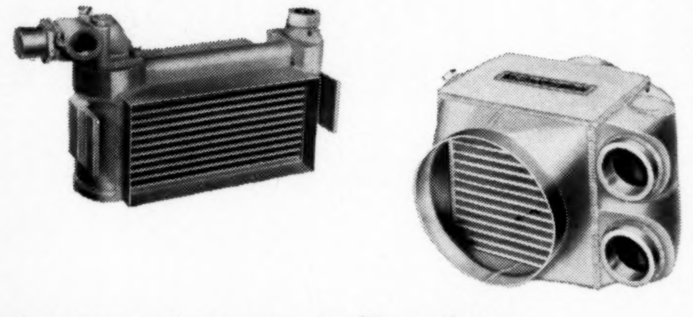

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lunar vehicles for which Hughes Aircraft Co. is prime contractor.

For investigation of solar particles, the laboratory will have a solar proton spectrometer on the Army's Advent 24-hr. communications satellites. Purpose of the experiment is to determine the energy spectrum of protons which might be emitted by quiescent-sun and flare conditions. Measurements will be made over a substantial period, probably for weeks. The detector portion of the spectrometer will be built at Aerospace.

Experiment for radiation belt measurements is being proposed for a polar-orbiting satellite, such as Midas. As a piggyback unit, the experiment will pass through the auroral zone for electron measurements.

Quantum physics activity will study radiation properties of the atmosphere —absorption and transmission for various wave lengths with respect to infrared and ultraviolet radiation. Results of this research could have substantial application to both anti-missile and space systems.

Upper atmosphere research will involve structure of this regime and will be supplemented in the laboratory with experiments with spectrographic equipment on ultraviolet in a vacuum, such as dissociation of gaseous molecules. A similar experiment also is projected for space flight.

- **Materials Sciences Laboratory.** Philosophy, work schedule and staff for this activity still are being built up. In the field of solid-state physics, the laboratory will concentrate on the effects of very strong magnetic fields on metals as a basic research effort to determine fundamental electronic structure of these materials.

Research will be a long-range effort to formulate a valid theory of constituent alloying.

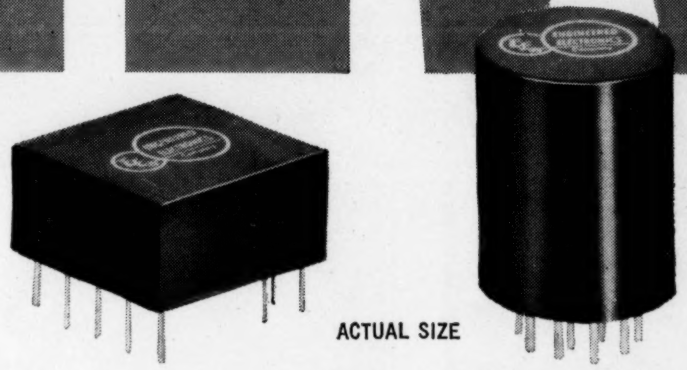
Precise group of metals to be investigated probably will include titanium and zirconium. Others such as iron, nickel and chromium, which have ferromagnetic properties, are likely to have value in electronic applications. Also, titanium and zirconium are refractory metals which are expected to find use in high-temperature, high-strength applications.

Typical work will support Air Force projects under way. Properties of infrared detectors will be studied for support of various satellite programs. The effects of ultraviolet radiation on solar cells also will be investigated.

Work in support of research in other laboratories will include investigation of the possibility of using superconducting magnets to obtain very high field strengths, with possible application to plasma propulsion.

In the field of applied science in metallurgy and ceramics, high tempera-

NEW



ACTUAL SIZE

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FROM LOGIC EQUATION TO SYSTEM PROTOTYPE IN ONE STEP

That's how simple it can be when EECO's new U-Series Digital NOR-Circuit modules are used. Engineering time can be spent designing **systems**, because EECO has taken care of circuit details. The first units of this new family of compatible germanium transistor circuit modules operate over the frequency range of 0 to 25 kcs. These units are designed to meet the requirements of MIL-STD-202B, as modified by temperature specifications of individual units.

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Two packaging styles are available. Both use **all-welded** electrical connections and both are encapsulated. Rectangular units with wire leads (to simplify dip-soldering) are available for installation on circuit cards. Cylindrical units with pins are available for installation in tube-type sockets. This latter package is admirably suited for system breadboarding. System wiring can be accomplished at the sockets; modifications in system design can be performed easily and rapidly. The cylindrical packages measure 7/8″ diameter by 1.0″ seated height. The rectangular packages measure 0.95″ long by 0.95″ wide by 0.5″ seated height.

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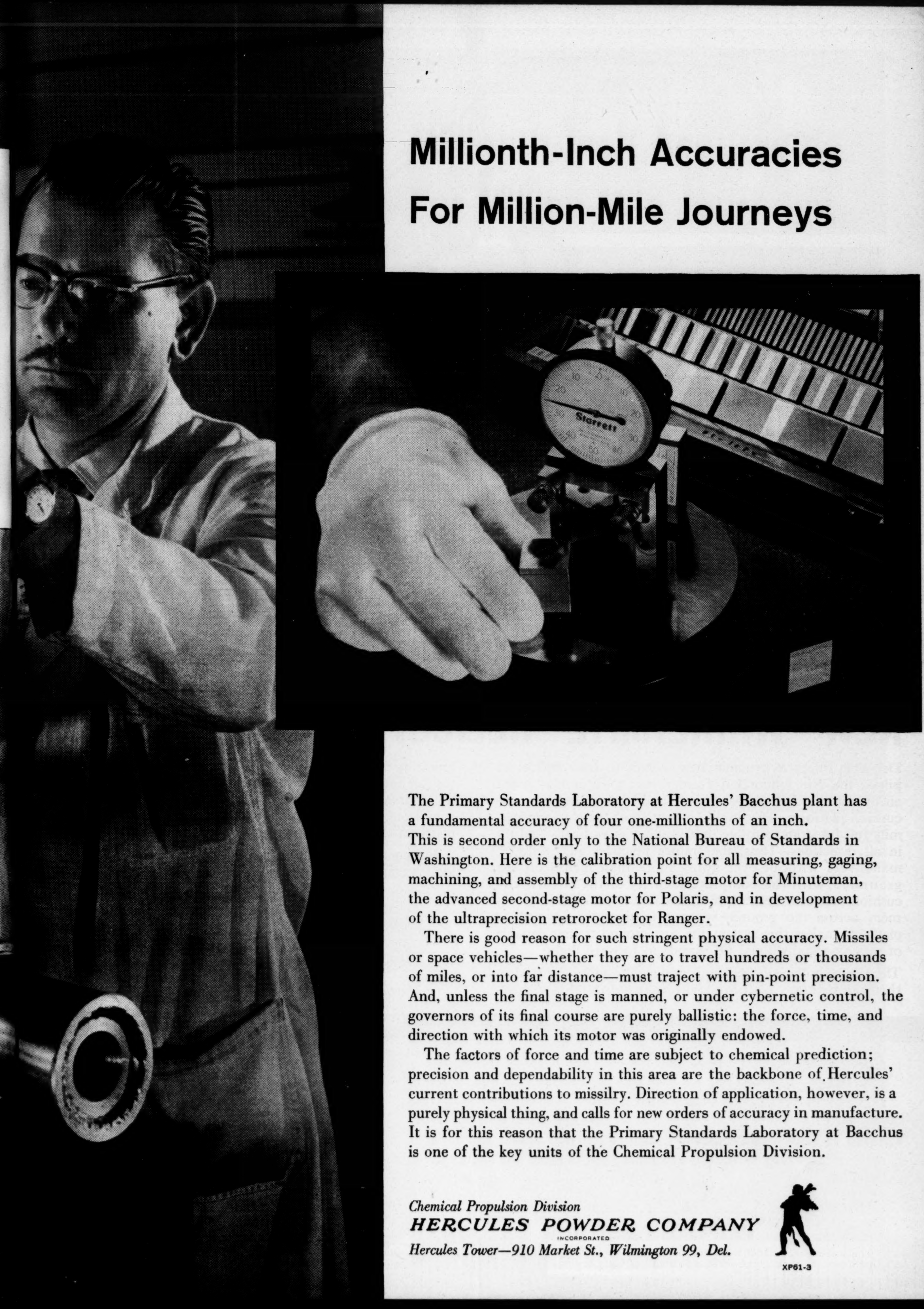

The Primary Standards Laboratory at Hercules' Bacchus plant has a fundamental accuracy of four one-millionths of an inch. This is second order only to the National Bureau of Standards in Washington. Here is the calibration point for all measuring, gaging, machining, and assembly of the third-stage motor for Minuteman, the advanced second-stage motor for Polaris, and in development of the ultraprecision retrorocket for Ranger.

There is good reason for such stringent physical accuracy. Missiles or space vehicles—whether they are to travel hundreds or thousands of miles, or into far distance—must traject with pin-point precision. And, unless the final stage is manned, or under cybernetic control, the governors of its final course are purely ballistic: the force, time, and direction with which its motor was originally endowed.

The factors of force and time are subject to chemical prediction; precision and dependability in this area are the backbone of Hercules' current contributions to missilry. Direction of application, however, is a purely physical thing, and calls for new orders of accuracy in manufacture. It is for this reason that the Primary Standards Laboratory at Bacchus is one of the key units of the Chemical Propulsion Division.

Chemical Propulsion Division
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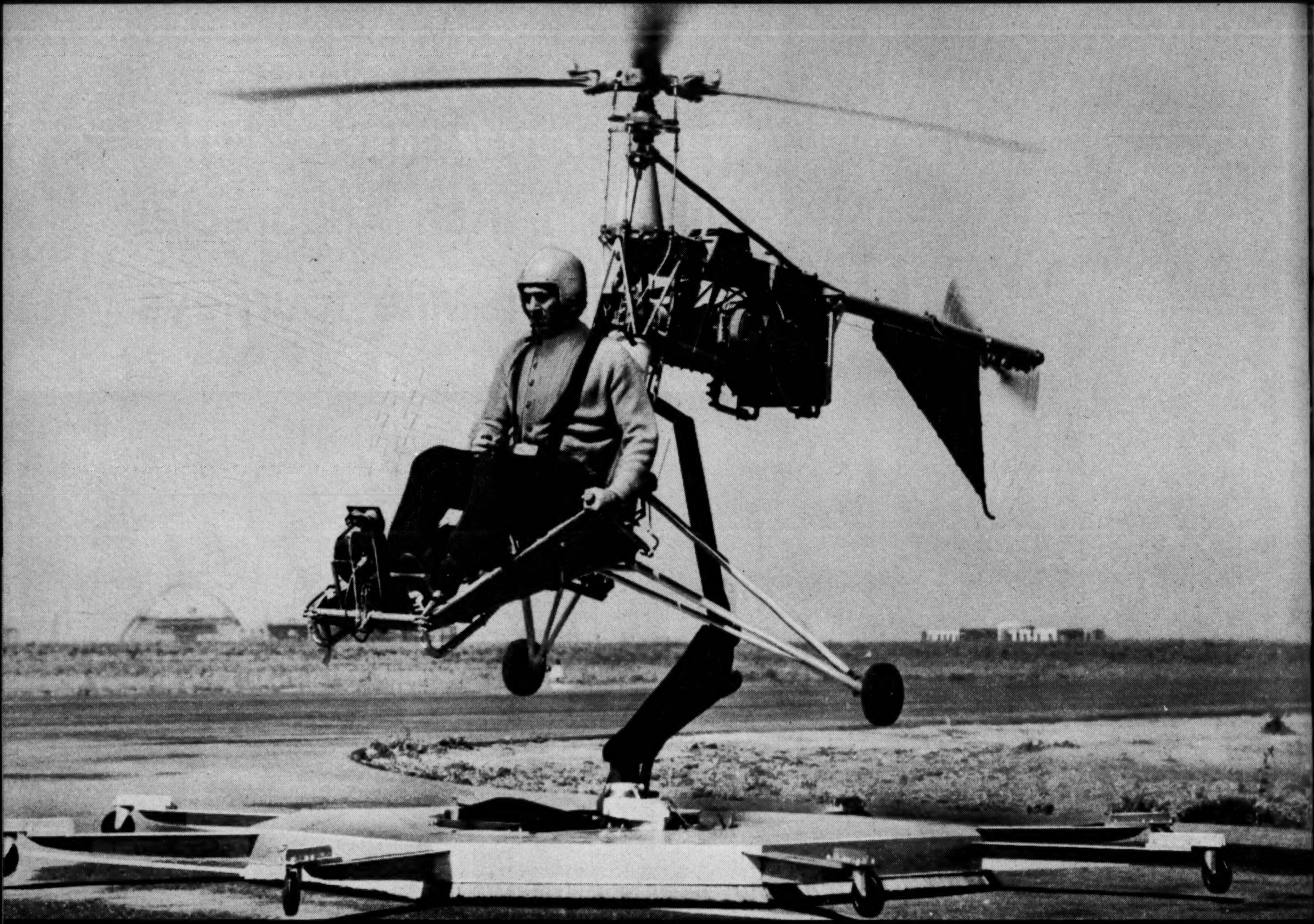

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NEW "WHIRLYMITE" HELICOPTER SELF-TRAINER

Del Mar offers a dynamic new system to train helicopter pilots: the Whirlymite Self-Trainer. It is not a simulator, but an operational helicopter mounted on a highly mobile, air-cushion platform. The unique mounting of the platform permits full freedom to rotate in azimuth, rise vertically and tilt in all directions. Thus, the trainee practices all "in-flight" maneuvers without ever going more than inches off the ground... with the complete security of the no-tilt, air-cushion platform beneath him. Because it allows free movement across the ground, without friction, the air-cushion platform makes this system the first ground trainer capable of attaining transitional lift speeds in forward flight.

The Whirlymite Self-Trainer is designed to move the student through primary training right up to solo flight, without requiring dual flight instruction. That means a single instructor can handle a number of students, simultaneously, through the training program. And, when the primary training is completed, the Whirlymite may be easily detached from the platform to become an operational helicopter.

For complete information on this versatile, low-cost training system, write for Data File AW-1546-2.

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ENGINEERING LABORATORIES

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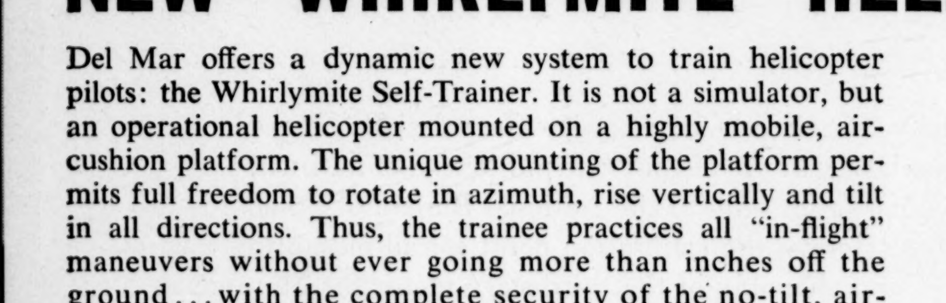
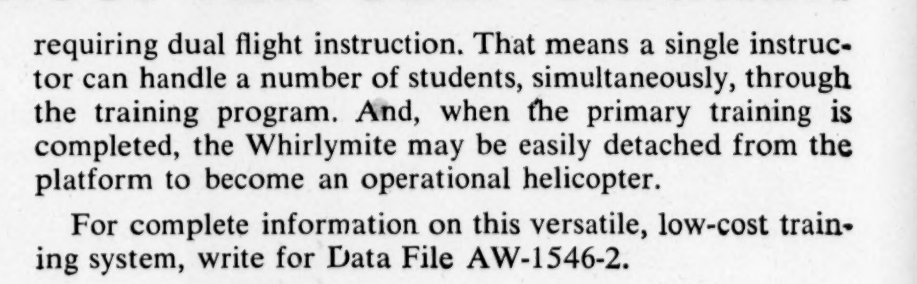


The one-man operational version of the ultra-light Whirlymite has successfully completed 50 hours of flight testing.



Drone instrumentation package (arrow) now undergoing evaluation gives the Whirlymite fully automatic, unmanned flight capability.

ture materials will be investigated to extend knowledge far beyond the degree of utilization required now. Effect of fabrication techniques on material characteristics also will be investigated.

For example, work already has been performed with beryllium oxide to determine the density as a function of temperature, time and pressure applied to the powder to produce plate material about $\frac{1}{16}$ in. thick. With this data, a theory has been formulated involving the critical shear stress and permitted prediction of the type of dense body which would be obtained under different processing conditions.

One possible use of beryllium oxide is in electrical insulators because of the material's high thermal conductivity and high electrical resistivity. Another characteristic of the material is its relative transparency to microwaves, suggesting application for high-temperature radomes or klystron windows. The material is not completely transparent, hence will absorb some microwaves and heat up, and because it is more resistant than aluminum oxide to thermal shock it may be suitable for very-high-power electrical applications. An outstanding characteristic of the material is that it is oxidation-proof.

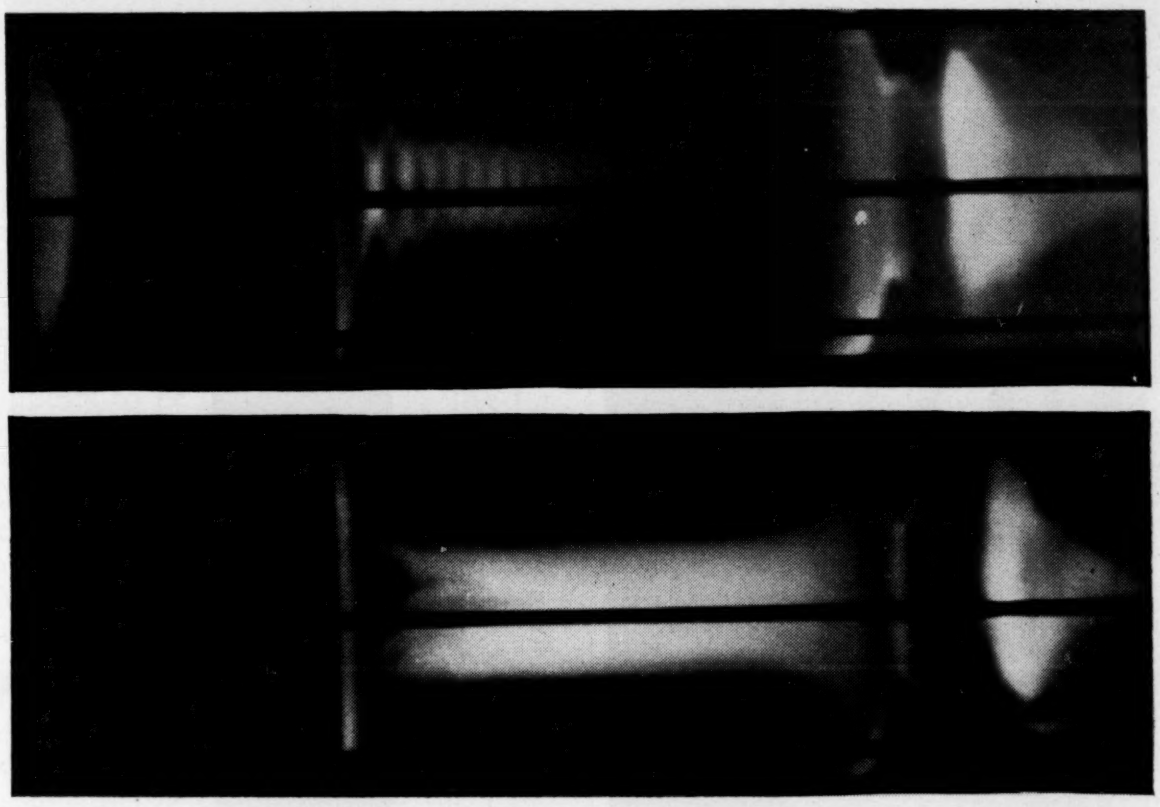
Other materials being studied for relation of basic physical and chemical properties to fabrication techniques include very high melting-point compounds such as the carbides, nitrides and borides.

The laboratory now has about 20 members of the technical staff and about five laboratory technicians. By the end of July, 1962, force level is expected to be about 60 technical staffers, approximately the full staff for the laboratory on the basis of present projections.

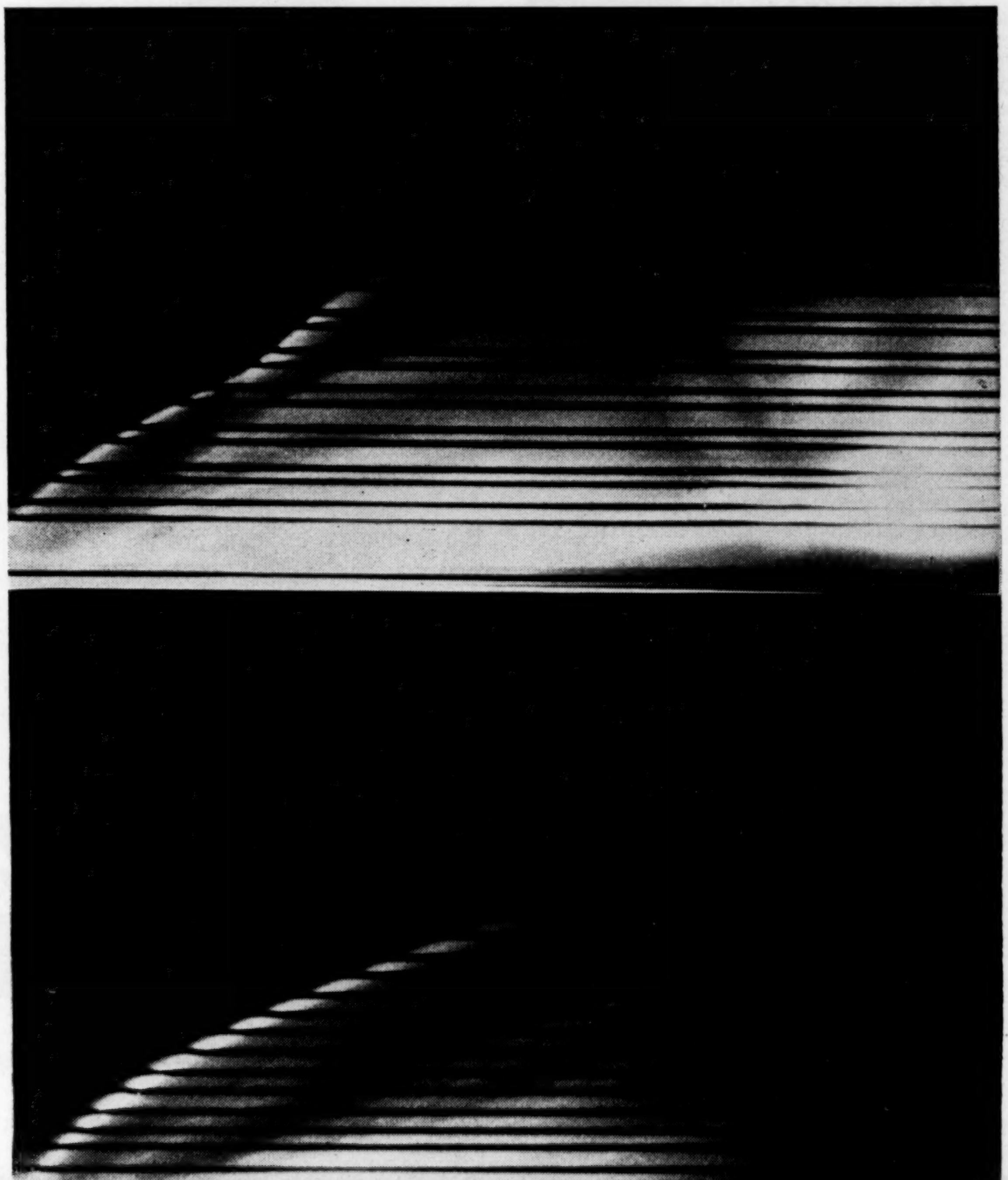
• **Aerodynamics and Propulsion Laboratory.** This activity provides technical support for major programs of Aerospace and also conducts its own research programs. The laboratory's Aeromechanics Department provides technical competence in the areas of aerodynamics, specifically ballistic missile re-entry, lifting re-entry and penetration aids (re-entry signatures and decoy studies).

Its Aerophysics Department is performing kinetic studies, with major areas of interest in high-temperature gas dynamics such as interaction of electromagnetic waves with ionized gases, and recombination of particles which have been dissociated or ionized. In support of this work, an experimental shock tube facility is used for studying recombination. Significance of the study is that it affects specific impulse, telemetry transmission and reception and re-entry signatures.

The Advanced Propulsion Department is in the process of being estab-



PHYSICAL RESEARCH LABORATORY streak photographs (above) show time history of luminous plasma column viewed through a slit transverse to column axis. Time is from left to right. In upper photo, pre-ionizing RF current produces initial contraction and current ends before beginning of main discharge. In lower photo, current and main discharge begin simultaneously and there is no radial oscillation (visible in top photo). Persistence of confined luminosity indicates some stabilization in operation. Hydrogen plasma (below) generated by discharging capacitor bank in hydrogen at initial pressure of 100 microns sends Mach 100, rapidly decaying shock wave through cold gas which dissociates and ionizes, resulting in electrical conductivity of 10^5 mhos/m. Lower photo shows initial shock and no magnetic field; upper shows same condition with moving magnetic field.



LH_2

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DEFENSE & SPACE DIVISION: General Office: Allentown, Pa. **DISTRICT LOCATIONS:** Dayton, Ohio; Washington, D. C.; Los Angeles, Calif.; Winter Park, Florida.

lished for conducting both basic and applied research. It will cover electrical propulsion—ion and plasma propulsion and techniques for accelerating ionized gases—thermionic converters, magnetohydrodynamic conversion, and facets of thermoelectric conversion.

Laboratory work is being performed on a thermionic converter, pulse plasma and arc plasma propulsion devices and magnetohydrodynamic energy generation.

The chemical propulsion department is calculating performance of advanced liquid and solid propellants which promise substantial jumps in thrust. Liquid hydrogen/fluorine propellant is being evaluated in relation to the entire range of factors which affect system performance. With solid propellants, the department is concerned with the effects of various type additives to improve impulse substantially.

Regenerative fuel cells for energy conversion are being studied. This borders on applied research, and phenomena related to electrode reactions as they affect over-all efficiency of the system are being analyzed.

Possibilities of organic semiconductors also are being studied. Theory is that if organic materials can be found which will conduct as solid-state devices, an entire field of inexpensive, simple transistor-type materials will be opened, with miniaturization possibilities.

Emphasis currently is on polyhydroxy and polycyano compounds which are likely to show unique electrical properties, different from those of metal or conventional semiconductors. Work primarily is experimental, requiring extensive organic and physical laboratory facilities, which Aerospace has.

Heat Transfer

Heat transfer and fluid mechanics activity is investigating advanced nozzle configurations, and thrust vector control devices for solid propellants. Ablation phenomena are being studied both for propulsion and re-entry applications. Aspects of nuclear propulsion also are being considered, such as phenomena associated with vortex reactor concepts of the gaseous nuclear reactor. This work is done in conjunction with Los Alamos Scientific Laboratories.

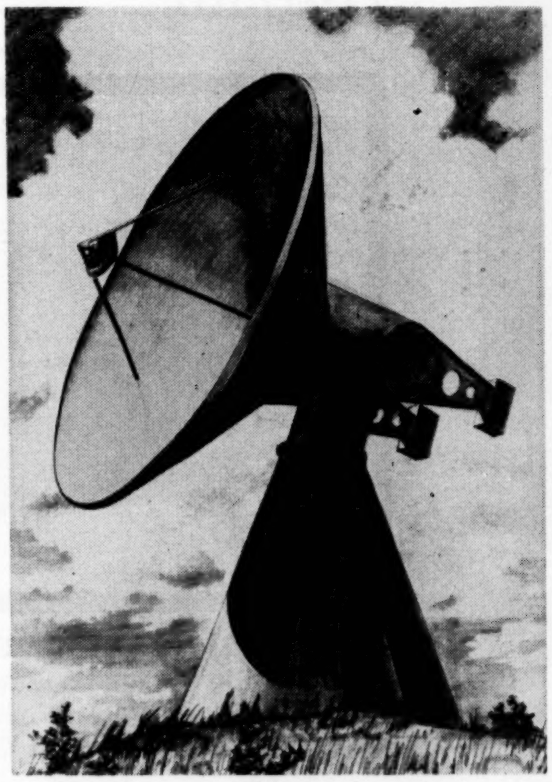
Approximately 55 members of Aerospace's technical staff are employed in the Aerodynamic and Propulsion Laboratory. Based on present projections, this number should increase to approximately 100 within a year.

- **Electronics Laboratory.** One of the very important space problems under study in this facility is that of deep space communications and wide-band telemetry, which now are operating near the limits imposed by vehicle antenna directivity, transmitting tube reliability, and available vehicle power.

Specialists in electromagnetic and communications techniques are studying sophisticated systems in which the antenna becomes an integrated part of the total communication system. For example, the use of automatic angle return arrays (Van Atta arrays) made active by printed solid-state amplifiers appears to be exceedingly attractive for megamile communications.

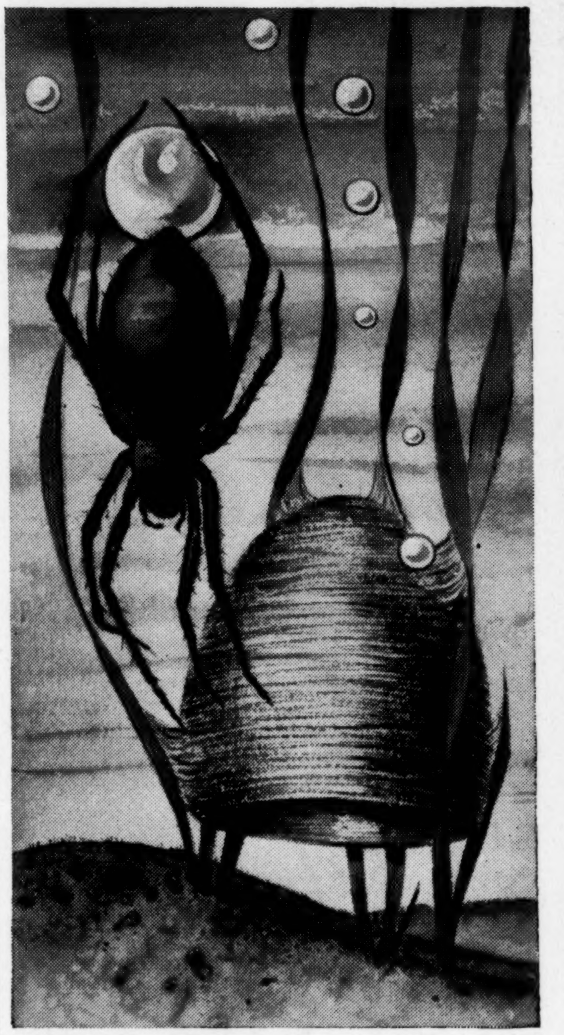
Another area considered of prime importance is quantum electronics, particularly the study of the behavior and application of the Laser (optical Maser), which permits coherent generation of optical and infrared radiation, making it possible to obtain light beams of very high directivity. Considered comparable in importance to the development of coherent microwave generators in the late 1930s, the Laser should permit order of magnitude improvements in ability to communicate, track, and perhaps destroy objects in space.

Solid state electronics activity is conducting a cryogenics program studying superconductivity in thin films. Feeling is that greater understanding of superconducting phenomena can pay huge dividends in space programs—which run the gamut from microminiaturization techniques to the use of ultra-high magnetic fields in propulsion systems. Head of the Laboratories Division is Aerospace Vice President C. W. Sherwin.



Boeing Antenna

Boeing Co. will enter large-antenna business with glass fiber reflectors which company says can hold their surface tolerance of 0.005 in. Sketch shows proposed antenna, with 30-ft. dish, which Boeing currently is proposing to several government agencies.



Engineered Environment

A good trick if you can do it and the water spider *does* . . . builds a watertight nest at bottom of a pond. She then pulls arm-loads of air bubbles down into the nest. In this air filled structure her eggs are kept free from surface enemies.

Securing modern defense installations against all environmental hazards is a challenging assignment—and one that is being met increasingly with specialized AAF equipment. AAF products designed to military specifications include complete environmental systems comprised of packaged liquid chillers, air handling units, portable air-conditioners, heater-ventilators and electronic carts to name a few. Advanced air filtration supplied by AAF protect against chemical, bacteriological and radiological contamination.

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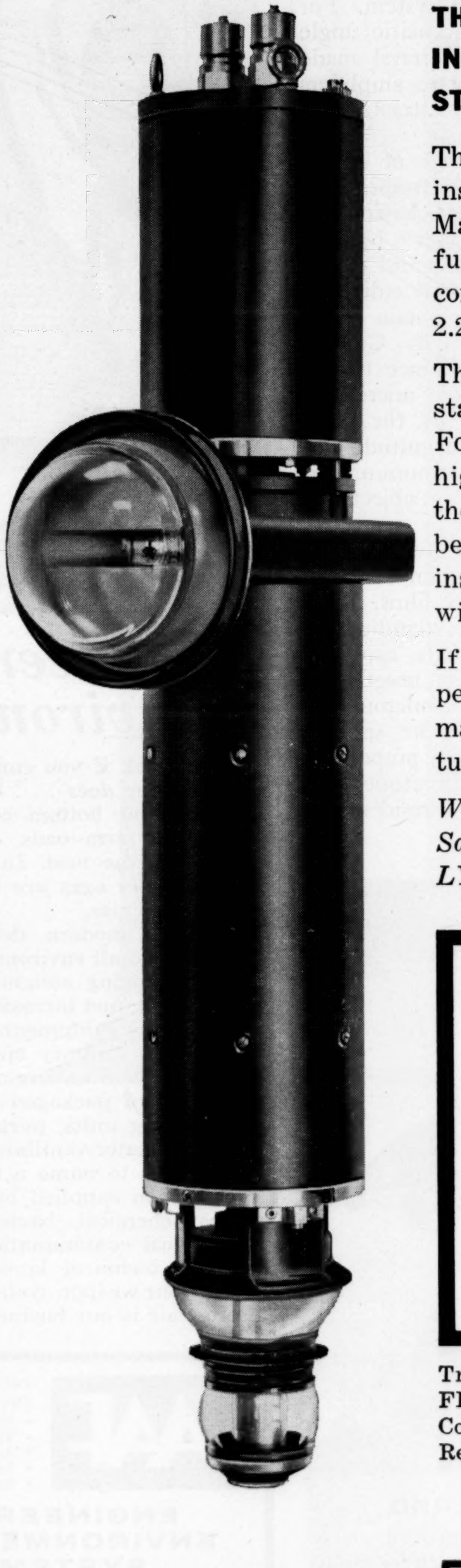

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There are good reasons for the longer life and more stable operation of Litton pulsed amplifier klystrons. For example, instead of removing contaminants by high-voltage operation during exhaust, we bake out the contaminants at extremely high temperatures before and after assembly and during exhaust. This insures the absence of contaminating molecules within the tubes.

If you're looking for long operating life, superior performance characteristics, and design and craftsmanship excellence in klystrons and other microwave tubes, see Litton Industries.

Write to: Litton Industries, Electron Tube Division, San Carlos, California. Or better still, phone: LYtell 1-8411.

Transmitters for the Air Force Search Radar AN/FPS-20, built by Bendix Radio Division of the Bendix Corporation for the Rome Air Development Center, Air Research and Development Command.

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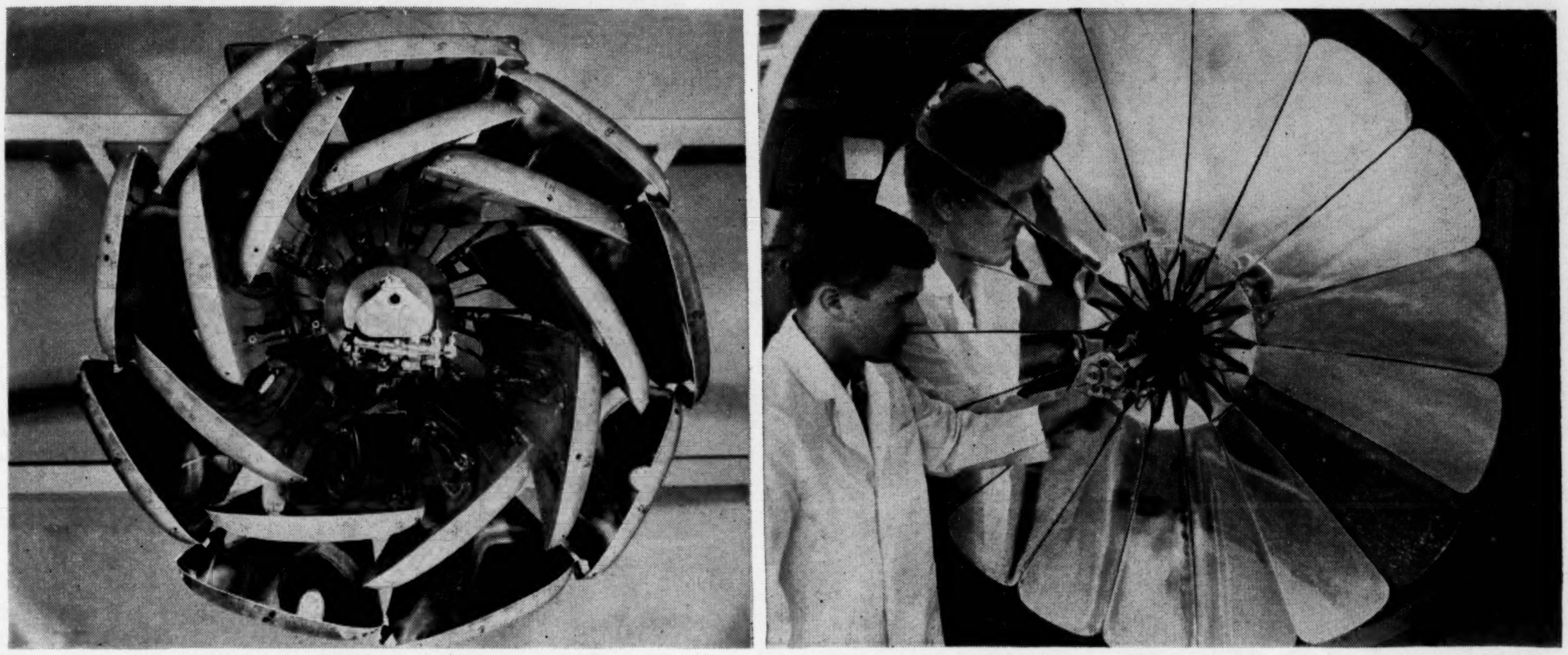


UNFURLABLE SOLAR COLLECTOR, capable of gathering in sun's rays and focusing them onto an absorber at its focus, consists of 18 electroformed nickel petals which can be unfurled from folded configuration (left) into parabolic collector, 52 in. in diameter (right). Feasibility model was made by Electro-Optical Systems, Inc., Pasadena, Calif. for USAF's Aeronautical Systems Division.

Unfurlable Solar Collector Is Developed

By Barry Miller

Pasadena, Calif.—Working model of a lightweight, parabolic collector capable of unfurling like a flower in space, then efficiently collecting and concentrating enough solar heat for a thermoelectric or a solar dynamic power system will be delivered to the Air Force shortly by Electro-Optical Systems, Inc.

Large area solar collectors are one of several important components that will be needed for those space power systems which will use the sun's heat as an energy source in converting solar to electrical energy. A number of different types including collectors which are inflatable, manually erectable or expandable are being developed.

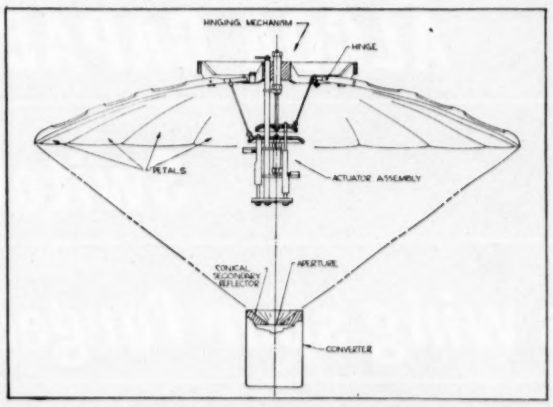
The model built here and being delivered to the Air Force's Aeronautical Accessories Laboratory of the Aeronautical Systems Division is intended to demonstrate the feasibility of a lightweight, petal-type (expandable) collector of satisfactory geometrical accuracy. It is 52 in. in diameter when expanded, considerably smaller than a practical unfurlable space collector would be.

Other companies are studying similar petal-type collectors. The Tapco group of Thompson Ramo Wooldridge, Inc., is designing and developing a 32-ft. diameter storable petal collector, which can be opened in space, as part of its participation in National Aeronautics and Space Administration's Sunflower I 3-kw. solar auxiliary space power system. Electro-Optical recently was asked by the Aeronautical Accessories Laboratory to make petals for a 42-ft. diameter collector under a separate contract.

Electro-Optical's model collector consists of 18 reflecting petals circularly arranged and hinged to an actuating assembly at the center of the array. The collector, not including the assembly or support, weighs about 2.5 lb. It can be expanded from its furled configuration in approximately 20 sec., according to Charles W. Stephens, associate manager of Electro-Optical's Advanced Power Systems Division.

Actuating mechanism employed in the feasibility model is a hydraulic motor although this might not be the appropriate technique for space operations. Since emphasis of the development was on the concept, the collector itself, and the quality of the petals, not the accessories, a manual system for keeping the collector properly oriented with respect to the sun was requested by the Air Force. The company found one of its own radiation tracking transducers more convenient.

In the process of furling, alternate petals are radially displaced about a tenth of an inch to provide proper clearance in the furling operation. These displaced petals fold in sequentially about 30 deg.; then the remaining leaves follow.



SECTIONAL VIEW of solar collector shows arrangement of components. Collector was developed by Electro-Optical Systems. Larger model of the device could be stored in space vehicles, then unfurled in space.

Electroforming Process

Collector petals are fabricated by an electroforming process which is more akin to investment casting. They are made entirely of nickel (except for hinging pins), overcoated with aluminum for achieving better reflectivity. The surface-reflecting area of each petal is about 0.72 sq. ft. giving a total reflector or mirror area of roughly 13 sq. ft. Specific weight of each petal is 0.2 psf., while weight of the nickel is 0.045 psf. per mil of thickness.

In fabricating the petals, the skin or surface of the mirror is formed on a mirror master whose smooth surface will be reproduced on the skin. A backing master is attached, the backing structure of the petal formed and the master then removed. An electroformed holder is attached and finally the petal is removed from the mirror master and overcoated with aluminum.

The petal collector can achieve a concentration ratio of at least 2,000

ALCOA CAPABILITY AT WORK . . .

Switch to die forging . . .

cuts wing spar forged weight by 895 lb

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Beam Modulator

Light beam modulator, which operates at microwave frequencies, has been developed by Sperry Gyroscope Co., Great Neck, N. Y. Company says device should find use in space vehicles for rendezvous purposes and for vehicle-to-vehicle communications.

compared with a better figure of about 12,000 for a solid reflector. The difference is accounted for by a larger focal area needed by the petal collector because of poorer reflectivity. Concentration ratio is the total reflector area divided by the area of the focal zone.

The sun's rays are focused onto an absorber at the focus of the parabolic collector. Depending on the coating placed on the petals, they have been able to individually reflect as much as 90% of the incident energy specularly. About 90% of the total reflected energy from the present mirror can be trapped in the 1-in. dia. focal area.

Efficiency of the mirror for operation with a Rankine cycle engine at 1,100F would be roughly 80%, where efficiency is defined as the ratio of power delivered to the engine to the power striking the mirror. A solid mirror at this temperature is about 85% efficient, Stephens says.

At higher temperatures, such as those which would be required by a practical thermionic converter, efficiency of both the solid and the petal collector would drop, the latter to a greater extent. A solid collector would taper to 77%, according to Electro-Optical's calculations, while the petal collector would fall to 60%. Hence, primary applications for the petal collector concept would be with solar dynamic and thermoelectric (static) power systems.

Micrometeorite dust would degrade the reflectivity of the mirror by about 1% a year if the mirror were employed on a satellite in a 300-mi. earth orbit, Stephens indicates.

AiResearch Division of Garrett Corp. has investigated petal collectors as one part of its work with solar dynamic space power systems. Its present interest is primarily with deployment of such collectors.

Another device for collecting the sun's heat is being produced by Goodyear Aircraft Corp. under a subcontract awarded recently by Sundstrand Corp. This will be a 44½-ft. dish-shaped inflatable reflector made rigid by foam plastic. It will be employed with a 15-kw., Rankine cycle turboelectric system (AW Aug. 22, 1960, p. 69) that Sundstrand's Turbo Division is making for USAF's Aeronautical Systems Division.

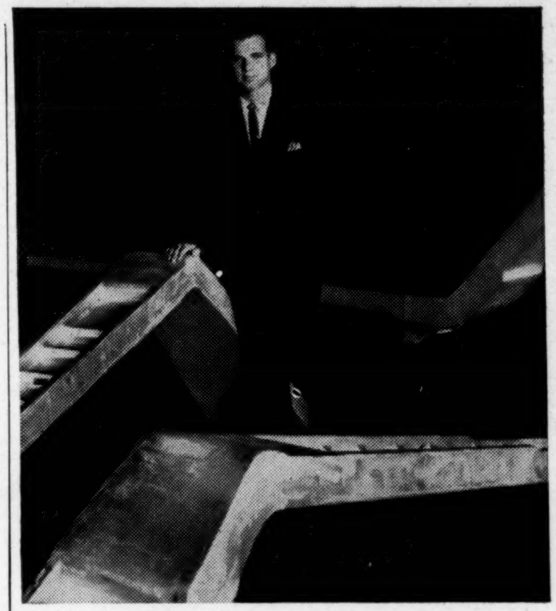
FILTER CENTER

▶ **Apollo Requires Special Radar**—Special moon landing and spacecraft radars will be sought by National Aeronautics and Space Administration in its requirements for avionic equipment to be used on the Apollo manned lunar spacecraft. The spacecraft radar will have to be capable of measuring the distance from the vehicle to the earth and the moon during flight. All avionics gear for Apollo, including communications, navigation, guidance and control, plus additional sensors will be obtained through procurement separate from current competition for the spacecraft and its propulsion (AW Aug. 7, p. 28).

▶ **Ballistic Missile Discrimination**—Signatures of ballistic missiles re-entering the earth's atmosphere will be studied by Electro-Optical Systems, Inc., under a $246,298 contract from Advanced Research Projects Agency.

▶ **Recent Corporate Actions**—Westinghouse Electric has formed Semiconductor Molecular Electronics Dept. at Youngwood, Pa., to develop, produce and market molectronic functional blocks. Fred M. Heddinger is general manager. Other recent moves on the corporate level include:

- **Raytheon Co.** and Indian businessmen have formed first transistor manufacturing company, known as Semiconductors Private, Ltd., at Poona, India. New facility, in which Raytheon owns one-third interest, is expected to be producing transistors and diodes by the end of current year, the company says.
- **Silicon Transistor Corp.**, New York, has acquired 90% ownership of Spasors, Inc., San Diego, avionics manufacturer. New acquisition has developed radio altimeter for low-altitude use which is expected to be accurate to within a few inches, the company says.
- **Space Craft, Inc.**, Huntsville, Ala., is a new company, formed by former employes of NASA Marshall Space Flight Center, to produce spacecraft and missile electronic equipment. Company president is William B. Greever.



SWITCH TO DIE FORGING... CUTS WING SPAR FORGED WEIGHT BY 895 LB

Originally a hand-forged shape, this 17½-ft wing spar forging weighed 1,600 lb. Alcoa called upon its vast resources of experience and facilities to find a better method of fabrication. Alcoa's capability broke the back of the problem. The solution: die forging. Utilizing advanced techniques considered impossible only a few years ago, Alcoa will forge the part on its 50,000-TON PRESS. The pay-off will be considerable: an estimated 920 hours saved in machining time . . . and weight of the forging cut to 705 lb. This breakthrough by Alcoa will pay an additional dividend to the aircraft designers by opening the door to greater design flexibility.

The die forging of this huge wing spar is a significant example of Alcoa capability at work. Alcoa . . . where the men, the metal and the machines can forge, extrude and cast the solution to your metal problems. How can we help you use this capability? Write: Aluminum Company of America, 1870-H Alcoa Building, Pittsburgh 19, Pa.

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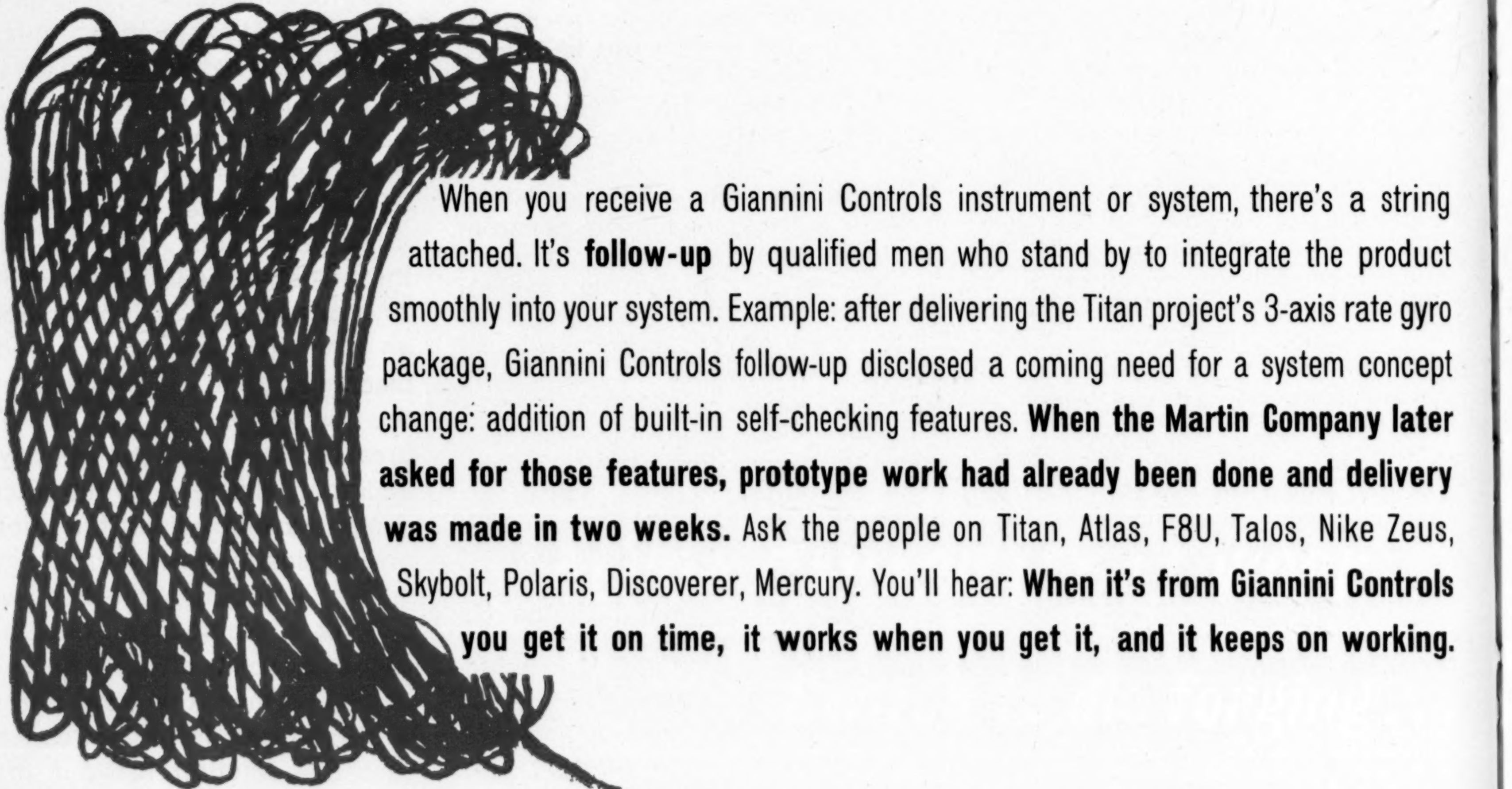
FOLLOW-UP



When you receive a Giannini Controls instrument or system, there's a string attached. It's **follow-up** by qualified men who stand by to integrate the product smoothly into your system. Example: after delivering the Titan project's 3-axis rate gyro package, Giannini Controls follow-up disclosed a coming need for a system concept change: addition of built-in self-checking features. **When the Martin Company later asked for those features, prototype work had already been done and delivery was made in two weeks.** Ask the people on Titan, Atlas, F8U, Talos, Nike Zeus, Skybolt, Polaris, Discoverer, Mercury. You'll hear: **When it's from Giannini Controls you get it on time, it works when you get it, and it keeps on working.**

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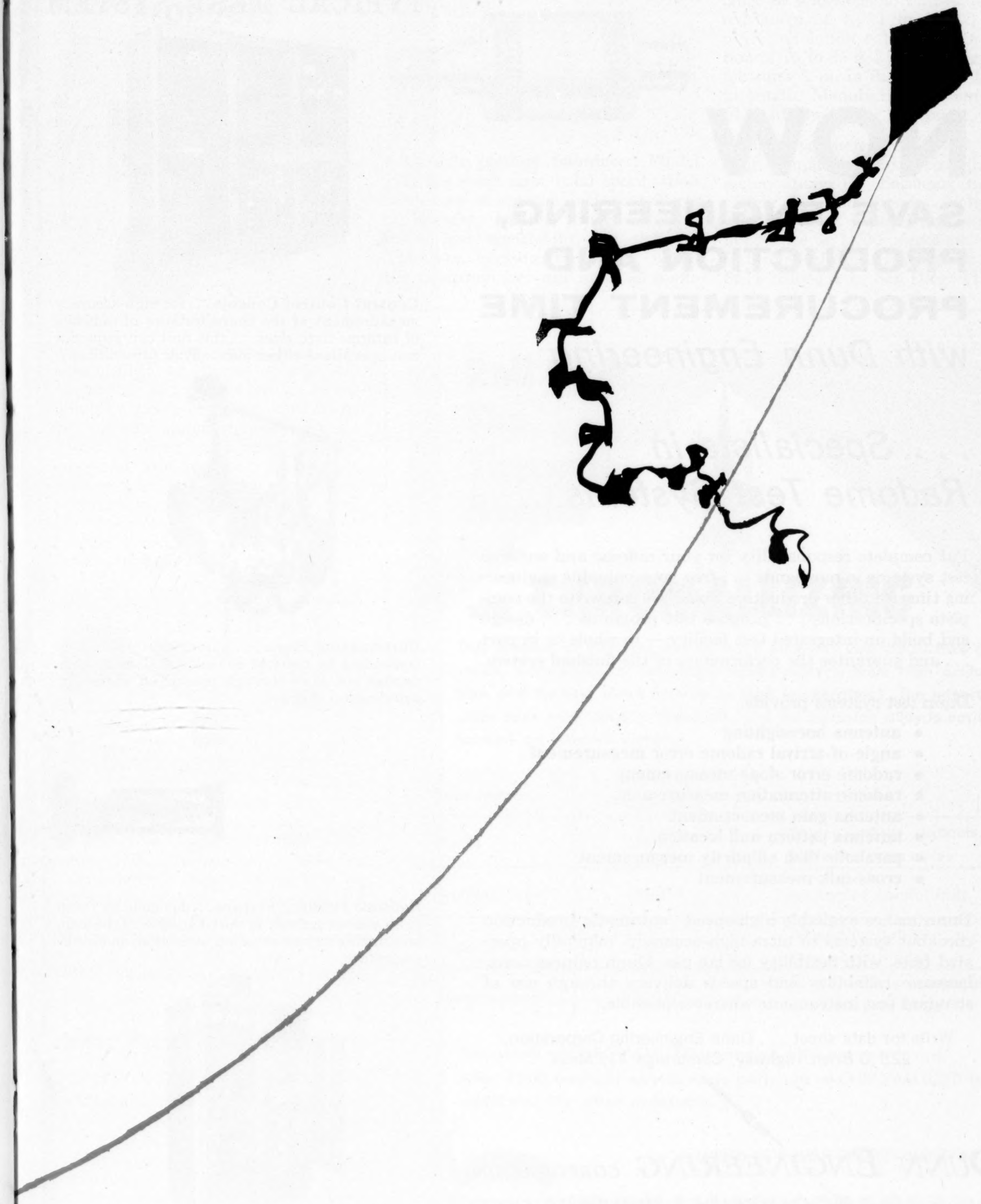

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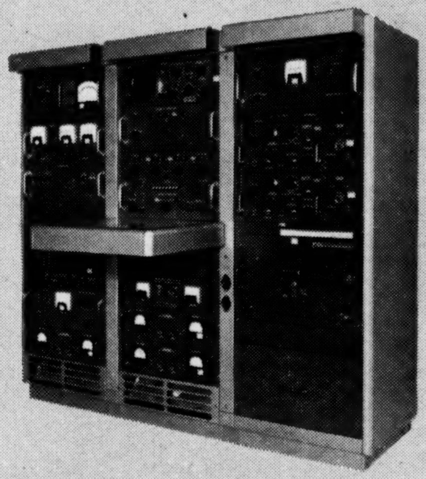
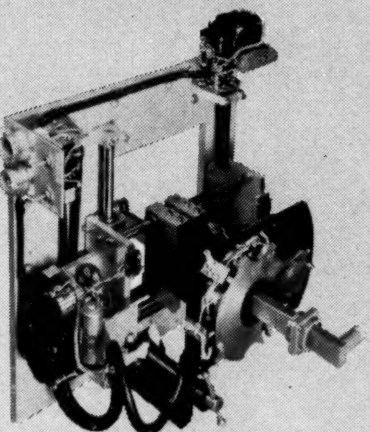
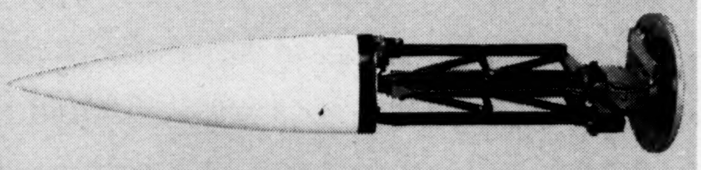
COMPONENTS OF A TYPICAL TEST SYSTEM



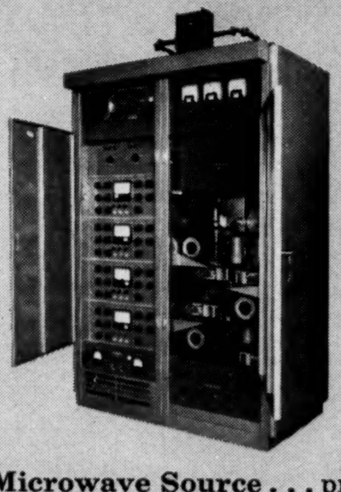
Central Control Console . . . for high-accuracy measurement of the characteristics of radomes of intermediate sizes . . . this unit can sequence test operations either manually or automatically.



Illuminating Horn . . . automatically remotely controlled by the test console. A Geneva drive rotates the horn through prescribed angles for polarization changes.

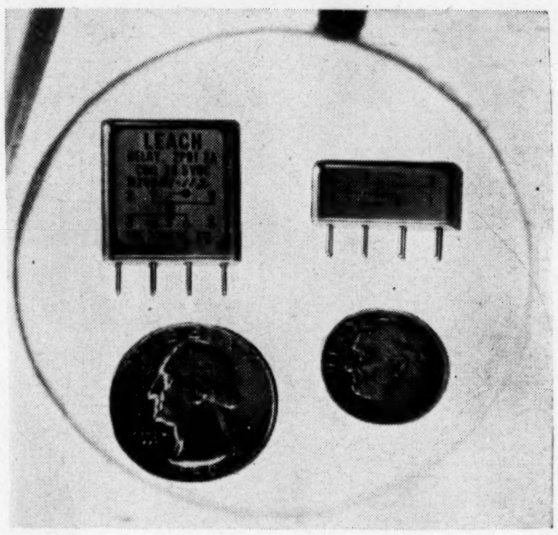


Radome Holding Fixture . . . designed by Dunn to be almost entirely in the r-f shadow of the dish, minimizing fixture coupling, reflection, and back-scattering.

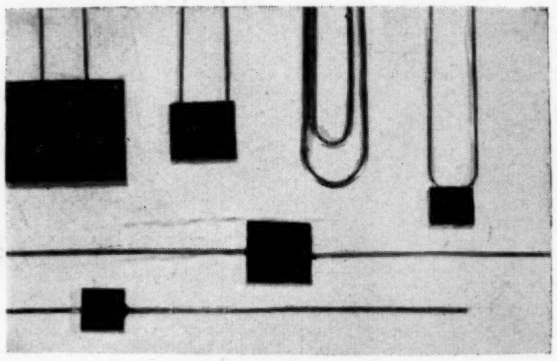


Master Microwave Source . . . provides pulsed microwave signals simultaneously at three different frequencies to a maximum of three radome test stations. Unit may be switched and controlled locally for test and adjustment.

NEW AVIONIC PRODUCTS

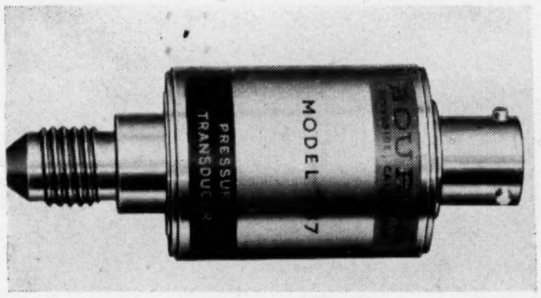


• **Crystal can relay,** Model M-250, occupies 0.128 cu. in. of volume and weighs 0.35 oz., is short enough to significantly reduce height occupied by relay between printed circuit boards. Three of these self-anchoring relays (shown at right in photo) can now be used in space occupied by single conventional sized crystal can relay with bent leads or pins, according to manufacturer, Leach Corp., Relay Div., 5915 Avalon Blvd., Los Angeles 3, Calif.



• **Microminiature capacitor,** using barium titanate dielectric, available in a molded ½ in. square (125 mil thick) case is latest in company's series of microminiature capacitors ranging in value from 0.01 to 0.075 microfarads. Recent addition to line is 0.075 microfarads, 200 v. d. c., with capacity variation of less than 10% from −55 to 150C. All values are available in 10 and 20% tolerances for fast delivery at prices which range from 30 cents to $2.00 each in quantity. Manufacturer: American Components Corp., 15222 Grevillea St., Lawndale, Calif.

• **Microminiature C-band oscillator,** Type 9180, measuring ¾ in. in diameter and ⅜ in. in length, is available as developmental model. For plate pulse use, oscillator can provide peak pulse power of 50 to 100 watts in the 4 to 6 kmc. range (tuning range is any 300 mc. segment of the 2 kmc. range). A CW version can tune any 100 mc. segment of the 4 to 5.5 kmc. range. Power output is approximately 5 milliwatts. Manufacturer: Trak Microwave Corp., Tampa, Fla.



• **Absolute pressure transducer,** Model 737, has static error band specification (a measure of accuracy including effects of linearity, friction, hysteresis, resolution and repeatability) of ±1.2%. This 4-oz. pressure transducer, which the company says will meet all applicable government specifications, has range of zero-4,000 to zero-10,000 psi., resistances of 1,000 to 10,000 ohms, ±5%, resolution as low as 0.2%, vibration of 16 to 35 g, 25 to 2,000 cps. and measures 1 in. in diameter by 1.48 in. in length. Manufacturer: Bourns, Inc., 6135 Magnolia Ave., Riverside, Calif.

• **Digital voltmeter,** Model 848, a four-digit, completely transistorized d.c. voltmeter/ratiometer. Balancing time averages 50 milliseconds. Voltmeter's accuracy is ± 1 digit, ratio reference impedance is 1,000 megohms. Manufacturer: Electro Instruments, Inc., 8611 Balboa Ave., San Diego 11, Calif.

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MISSILE ENGINEERING

SLAM Avionics Must Resist Radiation

By Erwin J. Bulban

Dallas, Tex.—Research by Chance Vought engineers on the effects of a high-level radiation environment on electronic circuitry and components required for the company's supersonic low-altitude missile (SLAM) program has been successful to the point where the engineers say that they can write specifications with reasonable confidence that the equipment will qualify.

Extensive studies here have taken the company past the component test level and basic circuit techniques have been solved, according to Vought. Under way now is testing of modules and combinations of various circuits.

Experience to date highlights the paths necessary for solution of installations in the nuclear-powered missile system, according to the firm. Confidence level is such among engineers working on the project that they say they could begin planning toward a specific flight date with 90% confidence that they would meet the target.

Success in this area is particularly significant since SLAM now is the sole military-funded nuclear-powered flight system, following cancellation of the manned aircraft program (AW Apr. 3, p. 26), and it promises to develop into a multi-billion dollar Strategic Air Command weapon system, industry observers indicate.

A major breakthrough in funding is expected this fall, with opening of a $15-$20 million Phase I competition for the supersonic nuclear-ramjet-powered low-altitude missile.

Such is the growing belief in the future of SLAM that a number of companies have been working with Chance Vought, spending their own funds to develop state-of-the-art knowledge that they feel will be valuable when the big payoff period arrives. Chance Vought currently has the only airframe contract on SLAM, a $1-million aerothermodynamics study involving the Pluto nuclear ramjet powerplant installation, and also has the principal guidance contract. Thus far it has also invested more than $2 million of company funds on SLAM studies and research.

Avionics Subcontractors

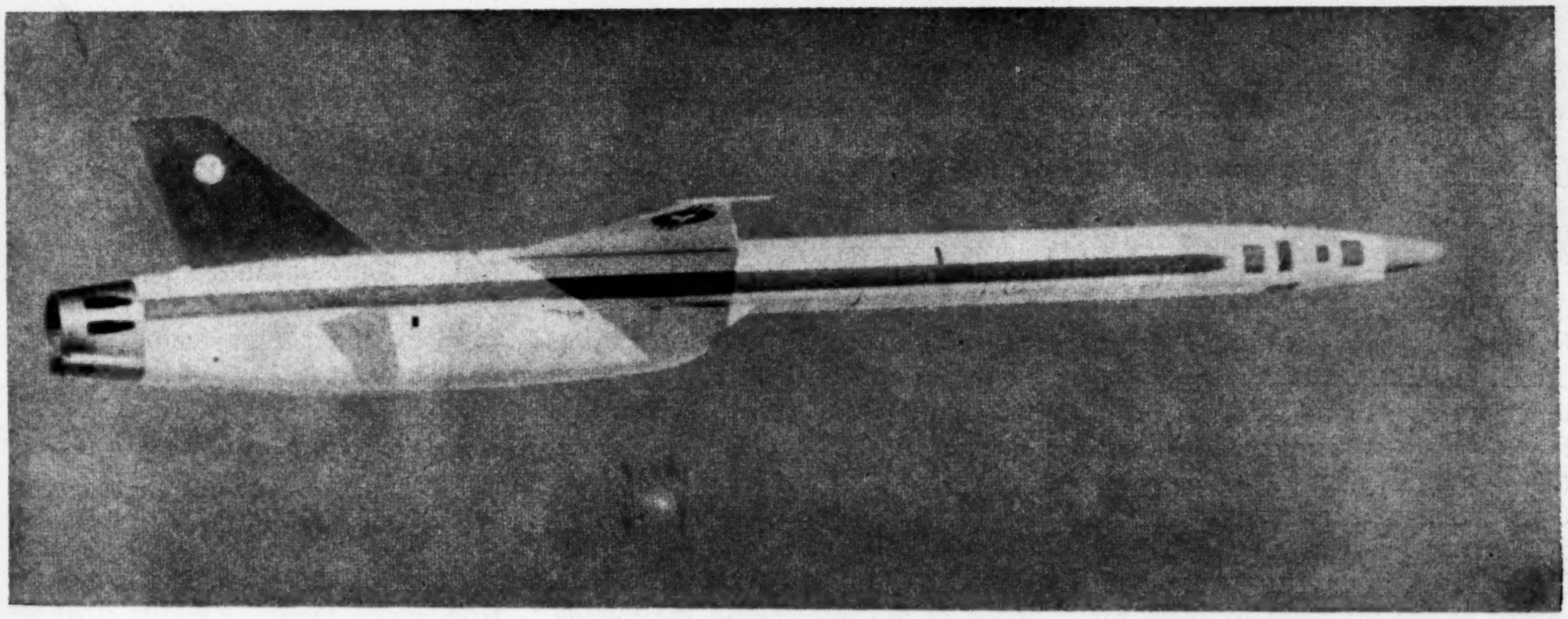
Approximately a dozen firms are contributing to Chance Vought's electronics research program involving hardening the systems to withstand effects of nuclear radiation. This teamwork, encouraged by Vought, has provided the kind of progress that leads its engineers to confidently forecast that no new inventions are required anywhere in the system to make SLAM a flight status vehicle. This couldn't be said a year ago, they add.

The company is preparing for an advanced phase of its SLAM electronics "hardening" program—that of proving the capability of the terrain contour matching (TERCOM) guidance system, for which it is the principal contractor. TERCOM Phase I has proven itself in the initial flight evaluation phase—aboard a twin-engine Air Force testbed aircraft—and now awaits study of how effective it will be under a radiation environment, utilizing radiation-resistant components and circuitry plus a new computer, which is out on contract.

Vought SLAM engineers are confident that the system will be able to perform under radiation, based on their past research.

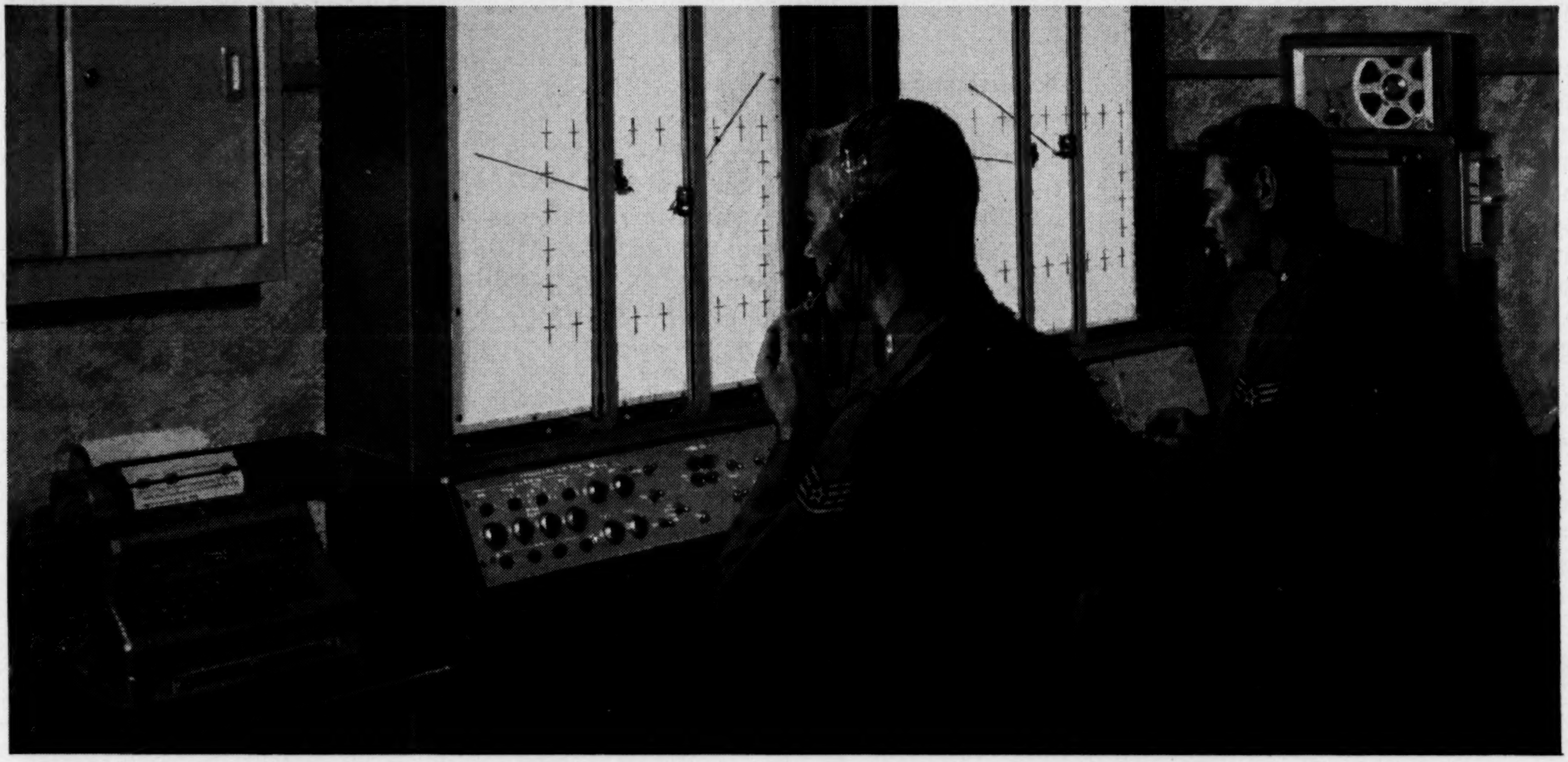
It is evident that the basic SLAM concept based on a nuclear ramjet propulsion system provides several important benefits to the engineer in systems design. Since the vehicle is unmanned he need not be concerned with the shielding problems relating to the human factor. The high performance of this powerplant makes weight problems secondary in equipment design, making circuit and component redundancy possible to improve the reliability level. Tests have shown that electronic components having a capability of withstanding more than a million times the radiation levels that can be tolerated by humans can be designed with reliability.

Chance Vought's approach in the electronics portion of the SLAM program has been to take available-now components and test them in radiation environments produced at General



Navy to Launch Q-4B as Target for Talos Missile

Q-4B missile target drones built by Radioplane Division of Northrop Corp. for USAF will be launched from Holloman AFB as targets for Navy Talos surface-to-air missiles. The Q-4Bs—prototype and test missiles left over from the recently-concluded USAF program—are being procured by Navy. The Q-4B (AW Sept. 26, 1960, p. 79) is powered by a General Electric YJ85-GE-5 turbojet engine with afterburner. The target, equipped with a parachute recovery system, is designed to simulate a Mach 2 bomber.



Cubic all-weather tracking system gives detailed analysis of ADC scoring missions

When a rocket or missile streaks from the armament bay of an interceptor over the Eglin Gulf Test Range and hurtles toward a target drone, a unique Cubic tracking system goes to work. Called MATTS for Multiple Airborne Target Trajectory System, it gives the Air Defense Command a complete running account of every phase of a scoring mission and prints out a full record of the intercept problem for later analysis.

MATTS has already demonstrated an unusually high level of reliability in continuous ADC operation. It has been scheduled as primary scoring instrumentation for ADC's next biennial weapons meet (Operation William Tell '61) to be held on the Eglin Range in October.

MATTS operates day or night, in any kind of weather, continuously measuring and plotting the trajectories of the interceptor, the missile and the target drone. The system tells everything about the mission, including the distance and direction of the missile from the target, and from the interceptor, at the time of simulated burst.

Cubic precision electronic tracking systems, of which MATTS is just one example, are in world-wide use for scoring, range safety, air traffic control, satellite geodesy and radar/telemetry acquisition. For information, write Dept. AW-108, Cubic Corporation, San Diego 11, Calif.

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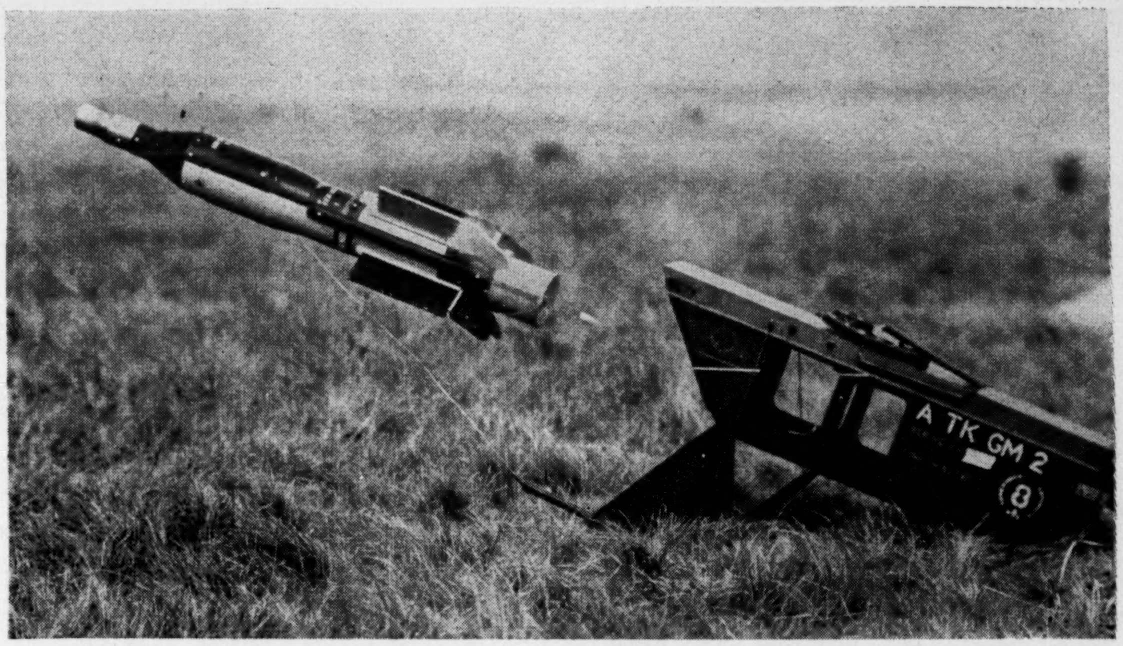
Dynamics/Ft. Worth's ground test reactor station.

Basically, the considerable research done here has indicated that materials that are high-temperature-resistant are inherently radiation-resistant and that solid-state type electronic components are sensitive to radiation effects.

As explained by Project Engineer John Mitchell, the radiation effects of the Pluto ramjet propulsion system, which is proposed for SLAM, for example, are in the range above electronic equipment radiation thresholds—over 10^{11} fast neutrons/cm.^{2} to 10^{15} fast neutrons/cm.^{2}, necessitating "hardening."

Radiation hardening techniques, which involve developing the nuclear damage threshold of each component by using the Radiation Effects Machine Analysis System (REMAS), have made it possible to raise the thresholds to 10^{17} fast neutrons/cm.^{2} and higher. In the case of ceramic tube devices, for instance, the level has been raised to 10^{18} fast neutrons, and successfully tested in operation under a steady-state nuclear environment for 100 hr.



Vickers Vigilant Anti-Tank Missile Fired

Wire-guided Vickers-Armstrongs Vigilant anti-tank missile is fired from its paradrop canister/launcher. Note hinged control surface on trailing edge of each of four fins. Maximum velocity of the missile is 450 fps. (AW Sept. 5, 1960, p. 34, July 24, p. 69).

Trends Noted

On the basis of these studies and with the background of considerable other research by other agencies, including those engaged in the Aircraft Nuclear Project, several general trends in characteristics of electronic components as a result of disorders afflicted by radiation were described by Mitchell, including:

- **Miniature and subminiature** tubes experience a general reduction of emission current, increase in control grid current and a change in transductance. Some tubes experience fissures in the glass envelopes or breaking of the glass-to-metal seals. Light-sensitive devices undergo an erratic increase in dark current due to gamma radiation and a change in sensitivity has been noticed because of discoloration of the glass.
- **Resistors are dependent** on material compositions and manufacturing processes. Initial resistance values of carbon composition resistors may change 10%, with higher resistance values showing greatest degradation. Wirewound resistors are the most stable standard type resistors for operation in steady-state radiation fields.
- **Capacitors** usually exhibit a change in capacitance, an increase in the dissipation factor and a decrease in leakage resistance.
- **Transformers** may be affected by expansion and deformation resulting from the change in structure of the potting compound and there also will be a reduction in insulation resistance between windings. In some cases, the magnetic properties of the transformer core are altered.

Recognition of these general trends permits hardening of most off-the-shelf equipment by following some basic steps. Mitchell mentioned these as follows:

- **Select** a reliable piece of equipment that will perform the required work function.
- **Determine** the environment—nuclear in addition to non-nuclear—in which the equipment must operate.
- **Evaluate** each component of the equipment to determine if it will meet the environmental requirements.
- **Eliminate** the weak links and replace with more radiation-tolerant components.
- **Redesign,** where direct component substitutions are not possible, to compensate for the radiation effects, or redesign to utilize a different, more radiation-tolerant, component.
- **Keep the circuit** design as simple as possible.
- **Be careful** in circuit arrangement to avoid placing high impedance lines adjacent to one another and keep circuit layout "clean."

Component Tests

Tests on actual components and circuitry that were assembled in breadboard form, and then operated dynamically throughout during a 100-hr. radiation exposure period, with complete set of circuit operating data being taken every two hours, showed these results:

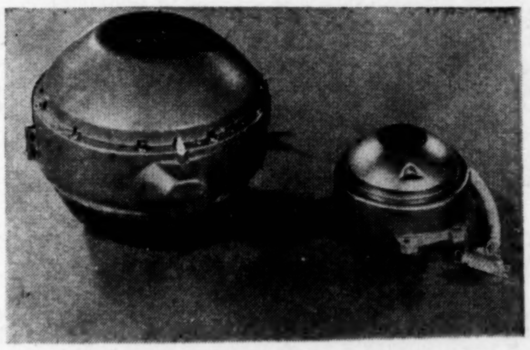
A transistorized valve drive amplifier failed completely within a half-hour after the radiation test started. The time integrated fast neutron flux was approximately 5×10^{13} fast neutrons/cm.^{2}. But this failure was expected as the circuit had been included only as a reference for comparison of actual damage.

One demodulator circuit, utilizing an SN-1724H ceramic electron tube failed after 45 min. of radiation, but this is believed to have been a random failure rather than a result of the test, since an identical circuit remained operational for the complete 100 hr. of testing.

A synchronizer amplifier failed to operate properly after 43 hr. and completely recovered at 73 hr. and continued to operate properly for the remainder of the trial. The cause was determined to be a temporary change in a component characteristic.

A motor driver amplifier failed after some five hours of radiation and another motor driver amplifier became very sluggish after some 60 hr., failing completely at 90 hr.

Twenty of the 24 circuits tested were still functioning properly at the end of the 100 hr. of irradiation.



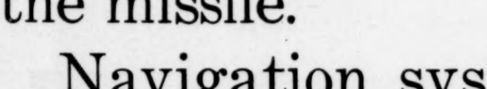
Miniaturized Gyro

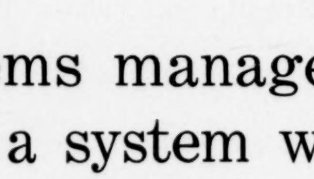
Miniature G8 gyro with two degrees of freedom (right), developed by American Bosch Arma Corp., weighs only one-fourth as much and occupies only one-fifth the volume of similar gyro which Arma builds for Atlas inertial guidance system (left). New gyro uses an inner gimbal which is a sealed floated beryllium sphere containing spinning rotor. Another floated solid beryllium ring provides second degree of freedom. Arma says it expects to apply new G8 gyro to advanced ICBM guidance and space vehicle navigation, as well as use it for azimuth alignment (north-seeking gyro) purposes. Gyro was developed under Air Force sponsorship.

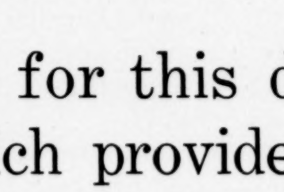
deterrence

In Navy's Polaris missile system—a major contribution to free world defense—it's a matter of "as the submarine goes, so goes the missile."

Navigation systems manager for this deterrent weapon, Sperry has evolved a system which provides the navigational accuracies required over the weeks and months a submarine is submerged. An inertial guidance system, double checked by a complex of instruments and master computer, not only guides the submarine and pinpoints its position, but telegraphs directly into the missile the exacting data needed to start it on its way. Thus has navigation been called the key to undersea firings: one degree error in the sub's heading means a 20-mile miss for the missile. General offices: Great Neck, N.Y.

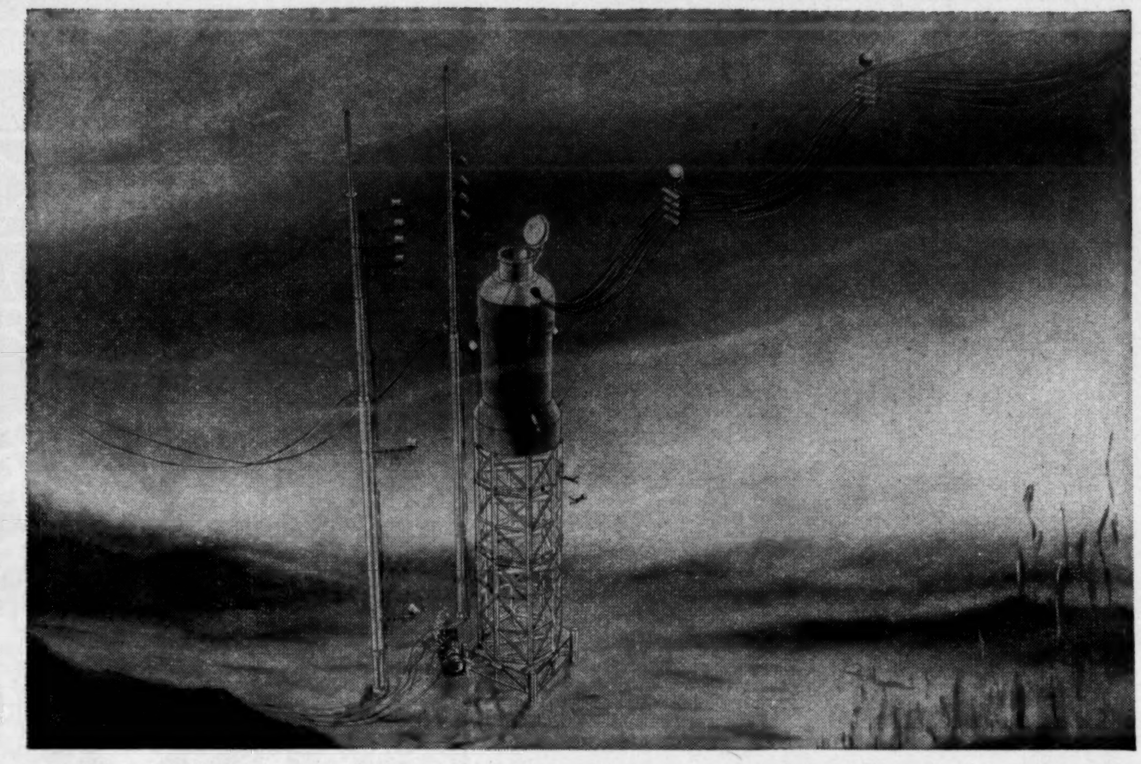






Other Sperry contributions to deterrent weapons: precision acquisition, tracking and guidance radars for Navy's Terrier and Talos missiles; bomb-nav system for USAF's B-58; Army's Sergeant missile system; Sperry's Polaris submarine navigation simulator (main illustration).

SPERRY



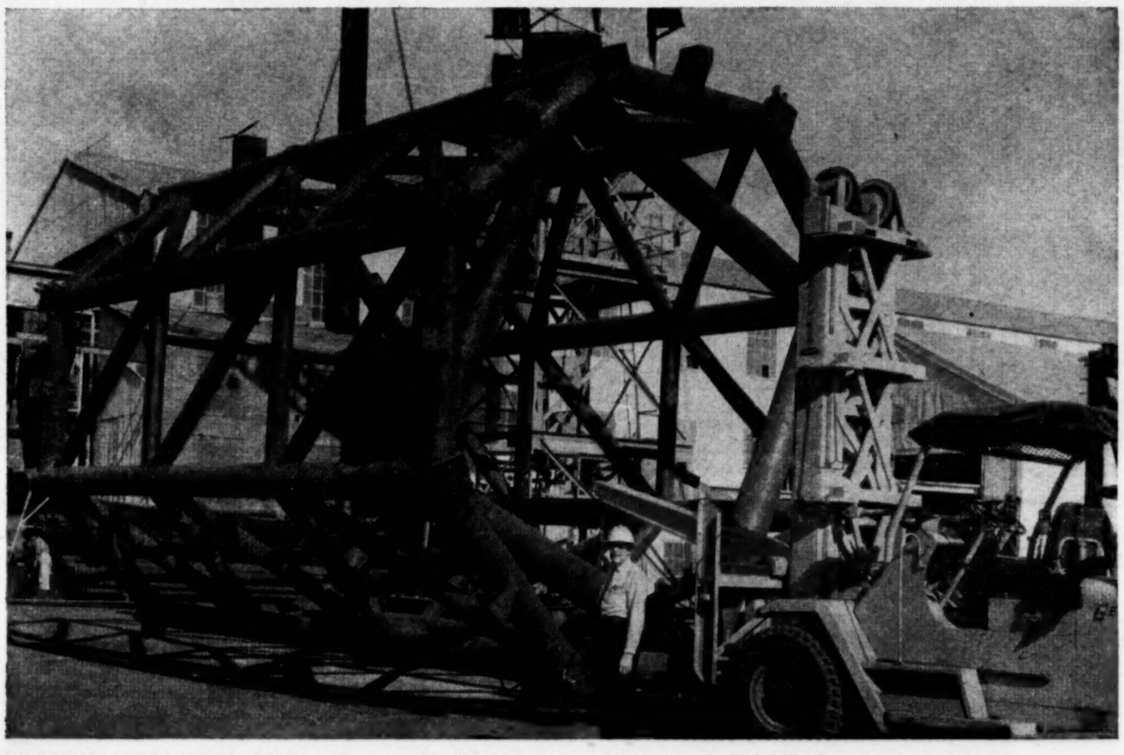
CAMERA TOWERS (left) hold underwater cameras to record launches from underwater Polaris test stand. Note hydraulic winch near tower base.

Underwater Launch Stand Installed

Variable depth launch facility completed for the Naval Ordnance Test Station, Pasadena Annex, in 170 ft. of water off San Clemente Island, Calif., will be used to develop advanced Polaris missiles which can be launched from a wide range of depths.

Security of missile-launching submarines from enemy action will be greater if the missile can be fired from greater depths. The launch facility off San Clemente should permit pop-up tests or live launches of Polaris missiles from approximately a 75-ft. range of depths.

The launch tower of the facility is buoyant and is made of four precisely manufactured steel spools in a stack mounted atop an eight-sided structure. A haul-down winch on the floor of the ocean controls the depth of the launcher. The structure is anchored to concrete-filled steel pilings set in the ocean bottom. The $900,000 facility has a total weight of 120,000 lb. and is able to withstand a 300,000-lb. eccentric load during the launch of one of the developmental Polaris missiles. Two telescoping camera towers are located about 25 ft. from the launcher and 12 high-speed underwater cameras will collect data on the underwater trajectories of the test missiles. Three television cameras are stationed to let observers watch underwater operations from the staging vessel and the instrumentation barge that houses controls for the test firings.



LAUNCH TOWER BASE, shown during construction, is eight-sided steel structure.

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BTI units are same as BMI, but 10,000 ohms output for transistor application.
BML band pass filters, similarly, work into a grid, but have an input impedance of 500/600 ohms. They provide a gain of 9.
HMI filters are high pass interstage units.
LMI filters are low pass interstage units.
HML filters are high pass with input and output impedance of 500/600 ohms.
LML filters are low pass filters with input and output impedance of 500/600 ohms.

BMI, BTI, BML, HMI, and HML special filters can be obtained for any frequency from 60 to 12,000 cycles. LMI specials are available from 140 to 12,000 cycles. LML filters are available from 500 to 12,000 cycles.

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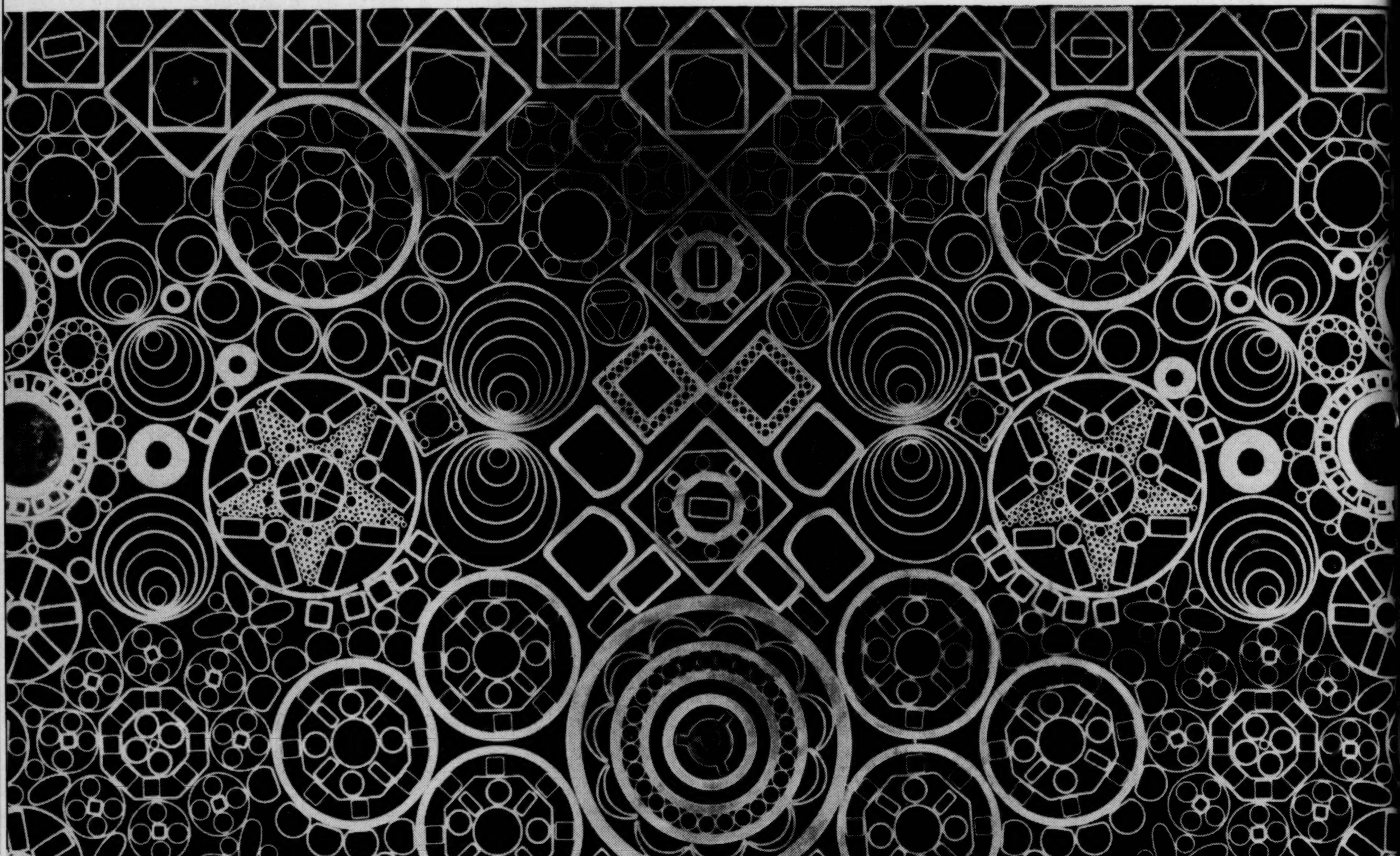

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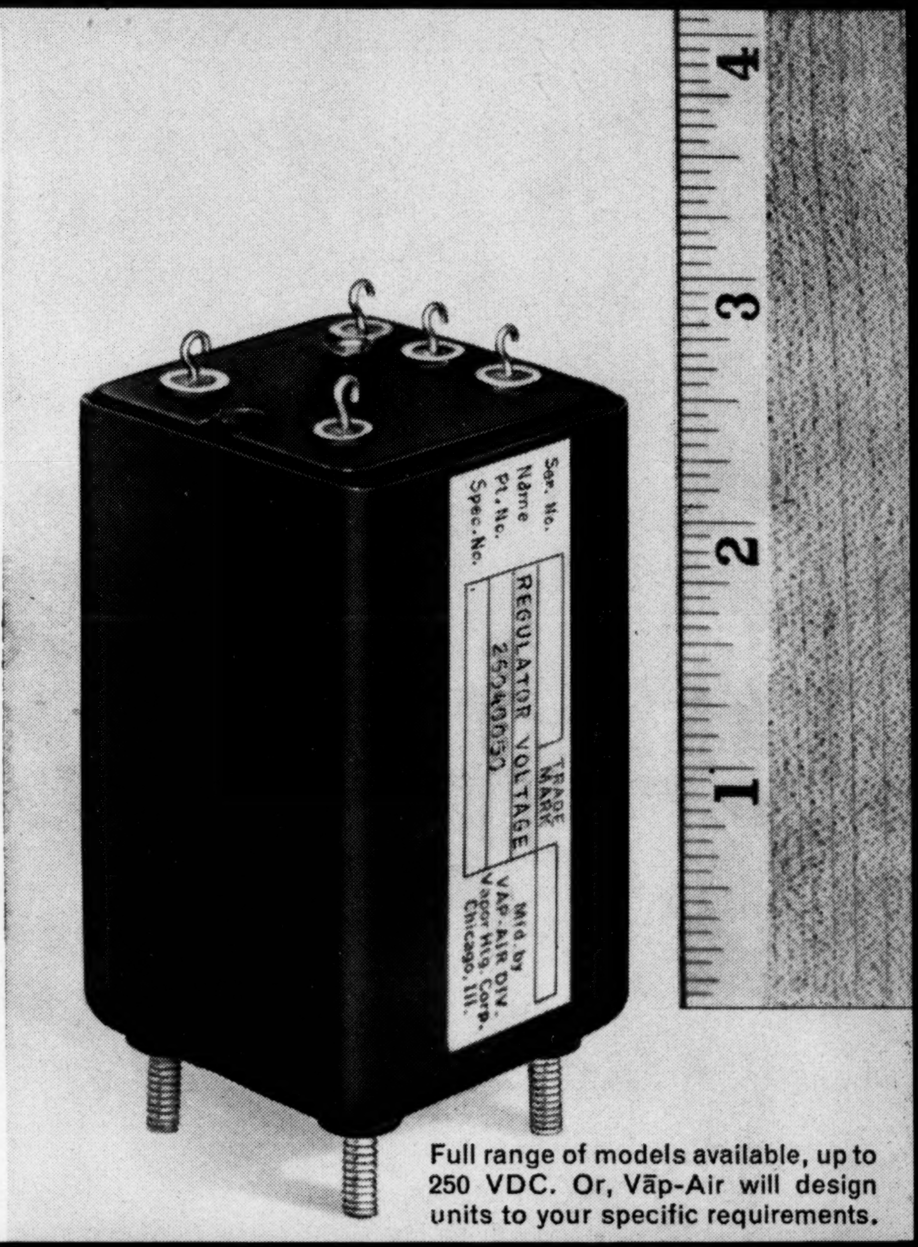

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Output Ripple (10V)	
Normal Operation	Zero
Transient Condition	30 MV peak to peak
Input Transient	80 volts above zero level for 10 to 20 millisecond duration
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Weight	6-1/2 ounces
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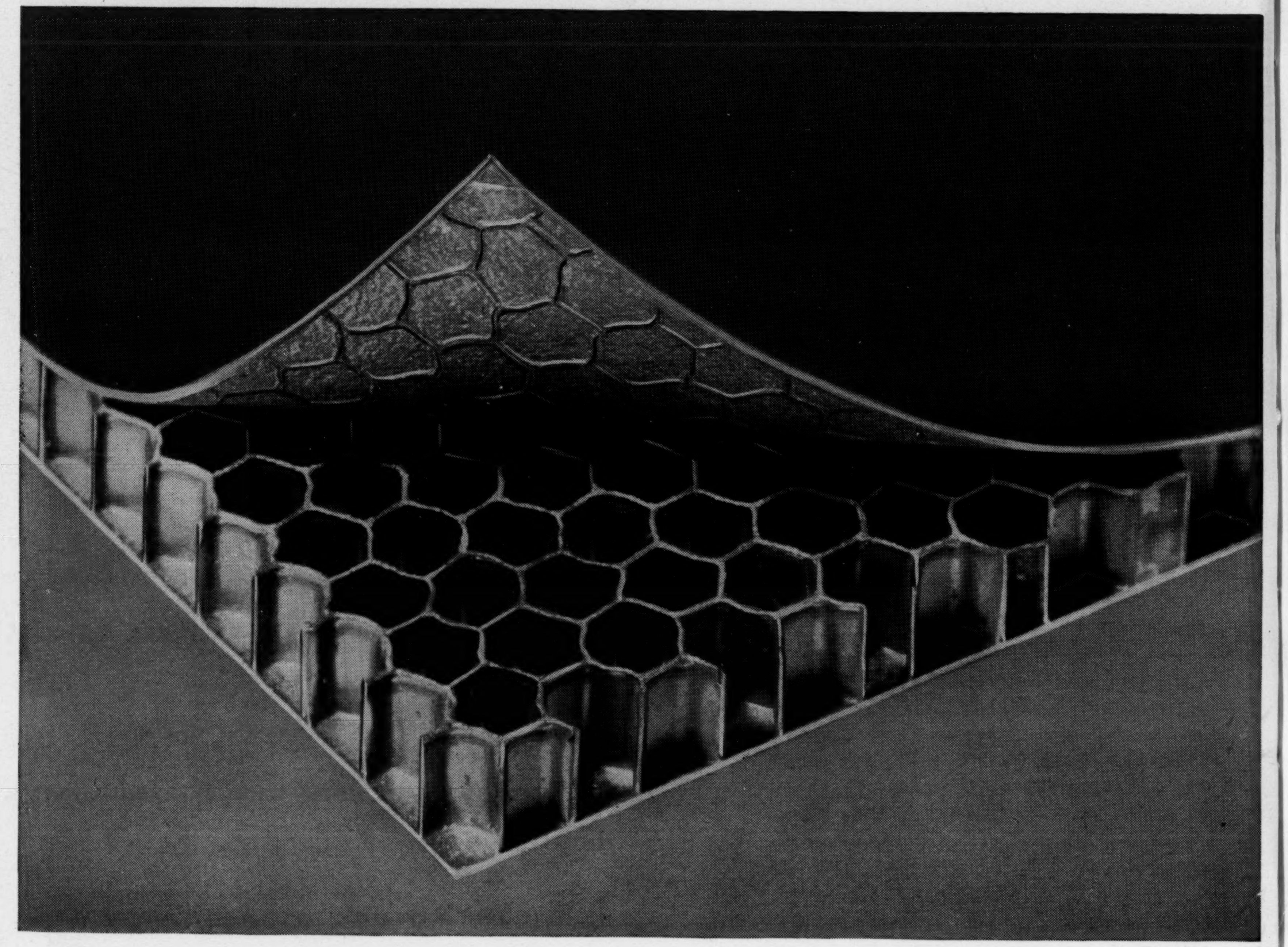

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FINANCIAL

Avionics Industry Growth Potential Seen

By Harry M. Raven

New York—Avionics industry as a whole is still a growth industry and, while some segments of it, such as radio and television, have run out of steam, others, such as data systems and space equipment, have phenomenal growth potential, according to Dr. Arnold O. Beckman, president of Beckman Instruments, Fullerton, Calif.

His company is not linked as closely to the national economy as some avionics firms, Beckman told the New York Society of Security Analysts, because it mainly produces end products for the scientific and industrial research and development fields. Thus, Beckman's market is less likely to be affected by the ups and downs of the economy than is an avionics company selling equipment used in manufacturing or tied to the consumer market.

Beckman manufactures complete data systems and instruments for analysis, measurement, counting, recording and control, and makes only a few components—usually only those which it can't procure elsewhere.

Beckman was in the semiconductor business through a subsidiary, Shockley Transistor Corp., until Apr. 1, 1960 when it sold Shockley, which had been operating at a loss since its inception, to Clevite Corp.

Divestiture of Shockley has turned out to be doubly fortuitous for Beckman, first because the company has been able to apply its resources more profitably toward other divisions, and second because with hindsight it looks as though it was just as well to voluntarily drop out of the semiconductor business, in which shakeouts are being predicted (AW June 12, p. 73).

Company's Aims

Beckman said corporate size is not his company's objective, acquisitions notwithstanding, but that growth in per-share earnings is. He said Beckman aims at achieving this by acquisition of companies making products with growth potential that are a logical extension of Beckman's product line, such as Offner Electronics of Schiller Park, Ill. This company, which Beckman is acquiring in a stock transaction, makes a direct-writing oscillograph and other products which will complement Beckman's space instrumentation, industrial and medical product lines.

Beckman said that return on investment is the criterion by which new product introduction is judged, and that a 30-35% rate of return is regarded as satisfactory for its products.

Other means by which the company is striving for growth, Beckman said, are by trying to keep out in front of its competitors, by keeping close watch on market requirements and by maintaining an effective research and development staff. On this last point Beckman said that 75% of all the company's offers to technical graduates last year were accepted.

Beckman's per-share earnings for the fiscal year ended June 30 are estimated at $2.50, based on Fiscal 1961 sales of $65.5 million and net income of $3.5 million. These are record sales and earnings.

Approximate Fiscal 1961 figures for both Beckman and Offner are: sales—$68.75 million; net earnings—$4 million; per-share earnings—$2.70, based on 1,460,000 Beckman/Offner shares of stock.

Beckman's Fiscal 1960 financial results were: sales—$54,257,282; net earnings—$3,092,915; per-share earnings—$2.24.

Thus Beckman ended Fiscal 1961 with sales up 20% and profits up 22% per share. Government contracts accounted for slightly more than 30% of total business, including $1.5 million for research and development contracts.

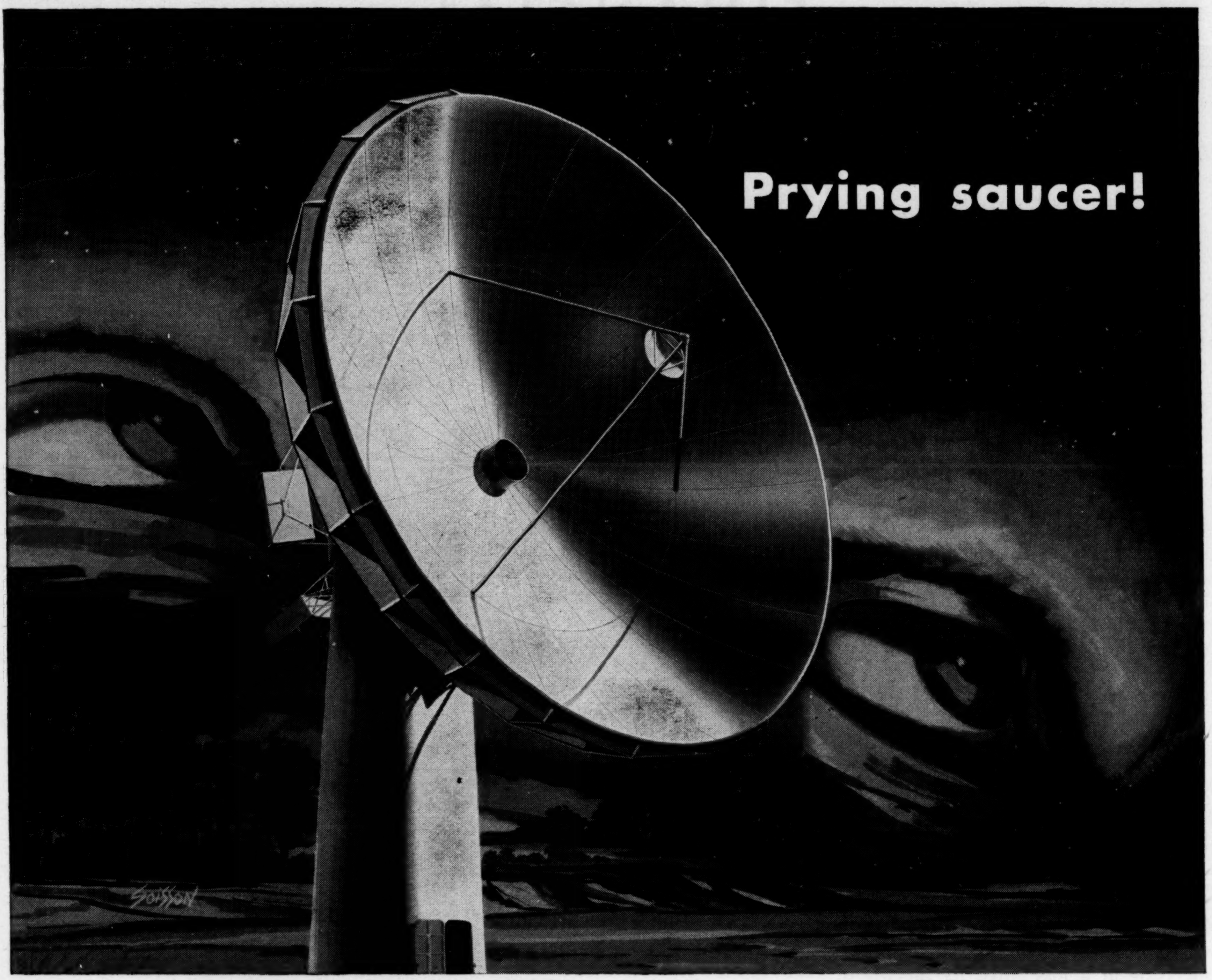
The company is "very active" in satellite communications, Beckman said, and looks for sizable research contracts for space project instrumentation. Beckman said this type of research contract is particularly desirable because it may lead to new products which can be produced for industry. Beckman is developing a lunar surface analyzer for Jet Propulsion Laboratory's unmanned, stationary Project Surveyor vehicles (AW July 3, p. 62), and developed and built some major components of the Project Mercury capsule telemetry instrumentation (AW May 22, p. 67).

The company's current growth rate is 20-25% a year and this rate is expected to apply to 1962 financial figures. The firm ended Fiscal 1961 with a record backlog, but the dollar amount of this backlog is kept confidential for competitive reasons.

William W. Wright, Beckman Instruments financial vice president and controller, told the security analysts that Beckman had a cash balance on June 30 of $7 million. With the working

Toxic Propellant Burner

Pyron burner system, built by Avien, Inc., will be used at Titan II facilities at Denver and Cape Canaveral to dispose of toxic propellants, such as aerozene 50 and nitrogen tetroxide.



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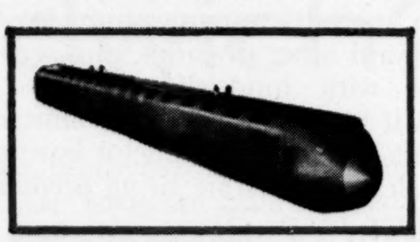
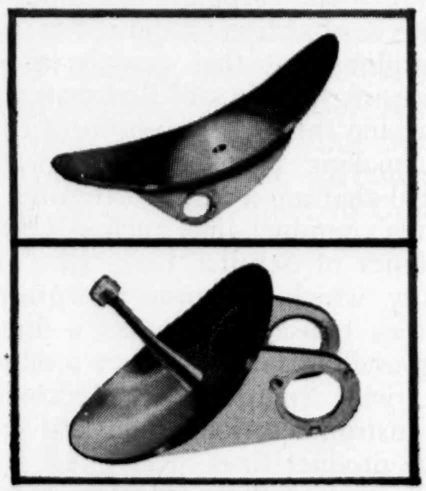


APS-94 ANTENNA SYSTEM included complete design of antenna for airborne side-looking radar.



B-58 BOM-NAV SYSTEM reflectors feature curvature tolerances of ±.005″.

capital required on an annual basis running about $2 million, Wright said that the $5-million remainder should serve the company's capitalization needs for about five years, based on a conservative growth rate.

The company received new capital of $7.8 million through an offering of 69,976 shares of common stock for subscription by stockholders on the basis of one new share for each 20 shares held (AW Mar. 27, p. 99). This offering was made for the purpose of paying off short-term bank loans and to help defray the cost of plant expansion and new equipment.

In Fiscal 1961 Beckman completed building programs costing a total of $2.5 million, including additions to engineering and manufacturing facilities at Fullerton and Palo Alto, Calif., and construction of a 100,000-sq.-ft. building at Fullerton for the Systems Division, which produces data processing equipment.

Capital expenditures in Fiscal 1961 were $3.9 million and depreciation was $1.7 million. Capital expenditures in Fiscal 1962 are expected to be $2.5-3 million and depreciation is expected to remain at the $1.7-million level.

Beckman common stock is listed on the New York Stock Exchange. The price recently moved up to the 130s, with a high for the year of 145¾ and a low of 87.

Mergers and Acquisitions

Air Products, Inc., Allentown, Pa., has acquired complete control of its British subsidiary, Air Products, Ltd., from the Butterly Co., London, England. The transaction, involving $2,436,000 cash, will be completed by September. Air Products had purchased a 51% controlling interest in the company in 1957. The British company, which designs, installs and operates oxygen plants and other cryogenic equipment, has annual sales exceeding $5 million.

Lionel Corp., Hillside, N. J., will acquire the government products division of parachute manufacturer M. Steinthal & Co., New York City and Roxboro, N. C. Martin and Augustus Steinthal will head Lionel's Steinthal Division following acquisition based on an exchange of stock. The company produces personnel and cargo chutes, jet aircraft drag chute brakes and space capsule recovery parachutes, with sales of over $6 million last year.

Fairchild Stratos Corp. has acquired Tribo-Netics Laboratories, Vermilion, Ohio, which specializes in gas-lubricated bearings. The business and equipment

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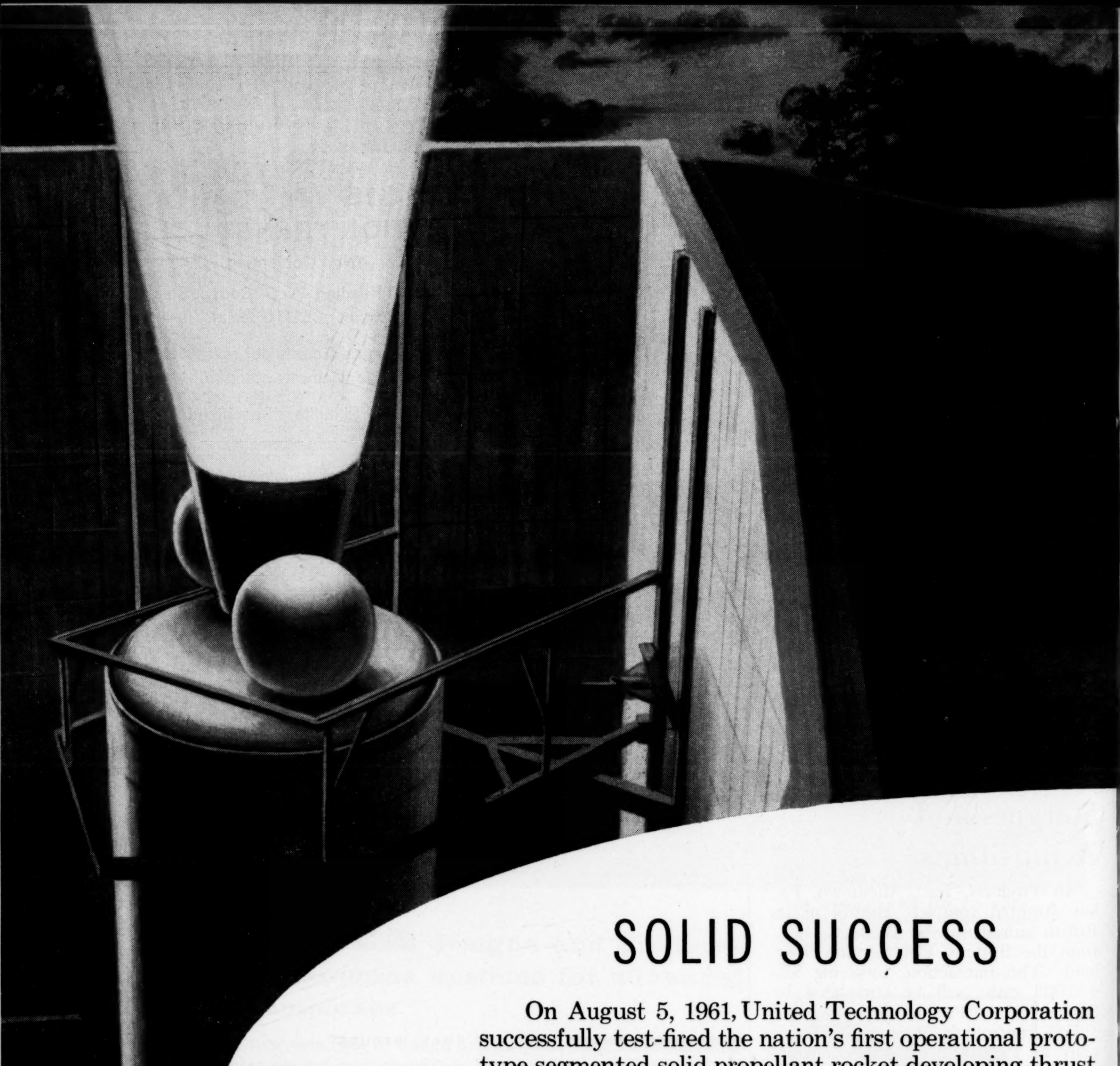

SOLID SUCCESS

On August 5, 1961, United Technology Corporation successfully test-fired the nation's first operational prototype segmented solid propellant rocket developing thrust in excess of 200,000 pounds. This major achievement is a significant milestone in the national program to develop multi-million-pound thrust boosters.

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will be transferred to Fairchild's Stratos Division at Bay Shore, N. Y. Fairchild also acquired assets of a Tribo-Netics affiliate, Advanced Precision, Inc.

Burndy Corp. of Norwalk, Conn., will acquire 50% interest in Escon, Inc., a subsidiary of Glass-Tite Industries, Inc., of Providence, R. I. Burndy and Glass-Tite will have equal representation on the new board of directors.

Butler Aviation has acquired all assets of National Aero Service Co., Midway Airport, Chicago. National's operations will be combined with the Butler Midway base.

Aerojet-General Corp. is buying 400,000 shares of the treasury stock of Global Marine Exploration, Los Angeles, a subsidiary of Union Oil Co. Global will work with Aerojet-General's recently organized Oceanic Division, which has been studying possibilities of launching large space vehicles from the ocean and of searching the ocean's depths for products useful for the nation's defense. Aerojet-General and Union Oil each will have 45% interest in Global, with Global personnel holding 10%.

Financial Briefs

General Mills had net earnings of approximately $12,800,000 during the fiscal year ending May 31. This was an increase of $1,300,000 or 11.2% above the previous year. Sales reached an all-time high of $575,500,000 and earnings per share rose from $1.46 to $1.63 this year.

Chicago Aerial Industries, Inc., of Barrington, Ill., reported sales of $4,852,247 and earnings of $16,529 for the six-month period ending June 30. Per share earnings for the period were three cents. Sales compared with $3,795,022 for the same period in 1960 and earnings were in place of a loss of $334,470 for the 1960 period. The avionics company currently has a backlog of $7,109,127.

Boston Capital Corp. has invested $500,000 in Electronic Research Associates, Inc., Cedar Grove, N. J. The investment consists of a $300,000 convertible debenture issue plus $200,000 worth of Class A common stock in the company.

Airborne Freight Corp. accrued gross income for Fiscal 1960 was $13,439,996, 12% above 1959. Assets of the corporation rose from $1,907,329 in 1959 to $2,426,805.

Collins Radio Co. had a net income of $2,700,117 for the nine months ending Apr. 30, 1961, or $1.22 per share of common stock. Net income for a similar period in 1960 was $5,901,605.

Air Force Research Grants

Washington—Air Force Office of Scientific Research has awarded 120 contracts and 17 grants totaling an estimated $5,223,140 since Nov. 1, 1960. Contracts and grants are summarized below:

Contractor	Date Work Started	Short Title	Estimate of Cost
	BEHAVIORAL SCIENCES		
Columbia Univ., New York, N. Y.	Nov., 1959	Comparative Impact of Actual Versus Anticipated Events	$50,004
Mass. Mental Health Ctr., Boston, Mass.	Jan. 1961 (Grant)	Effects of Prolonged, Atypical Sensory Input on Performance	9,396
Cornell Univ., Ithaca, N. Y.	Nov., 1960 (Grant)	Dimensions of Behavioral Ratings	10,392
Univ. of Mich., Ann Arbor, Mich.	Dec., 1959	Decision Processes	28,724
The Matrix Corp., Arlington, Va.	Nov., 1960	Reducing Stress in Military Groups	22,224
Princeton Univ., Princeton, N. J.	Jan., 1961	Factors in Learning Efficiency	30,202
Univ. of Texas, Austin, Tex.	Oct., 1958	Arousal, Management & Reduction of Hostility	11,389
Univ. of Mich., Ann Arbor, Mich.	Aug., 1958	Selective Factors in Cognition & Perception	28,212
Bu. of Soc. Scien. Rsch., Conn. Ave., Wash. 8, D. C.	Feb., 1961	Self-Management Techniques for Stressful Conditions	31,600
Human Sciences Rsch., Inc., Arlington	Nov., 1957	Integration of Small Group Research	15,170
	BIOLOGICAL SCIENCES		
Univ. of Calif., Los Angeles, Calif.	Aug., 1960	Biomedical Aspects of the Space Sciences	27,792
Univ. of Chicago, Chicago, Ill.	July, 1955	Application of Information Theory to the Nervous System	3,335
Univ. of Illinois, Urbana, Ill.	Nov., 1959	Electron Microscopy of Ultrasonically Irradiated Muscle	7,980
Lovelace Foundation, Albuquerque, N. Mex.	Dec., 1960 (Grant)	Mechanics of Ventilation & Pulmonary Gas Exchange in Man During Stress	41,100
Johns Hopkins Univ., Baltimore, Md.	Dec., 1960 (Grant)	Occipital-Parietal Connections in the Cortex	30,516
Univ. of Calif., Berkeley, Calif.	July 1959	Biological Effects of Air Ions	29,714
Univ. of Wisconsin, Madison, Wis.	Sept., 1958	Complex Precursors of Induced Enzymes in Yeast	16,797
Western Reserve Univ., Cleveland,	Nov., 1959	Vasopressin Biosynthesis	17,880
	CHEMICAL SCIENCES		
Columbia Univ., New York 27, N. Y.	Oct., 1958	Electron Spin Resonance	140,555
New York Univ., New York, N. Y.	Oct., 1960	Forces in Hydrogen Bonding	23,722
Princeton Univ., Princeton, N. J.	Nov., 1960	Equilibria in Ionic Polymerization	62,270
Princeton Univ., Princeton, N. J.	Nov., 1960	Kinetics of Electrolytic Film Formation	19,598
Yale Univ., New Haven, Conn.	Nov., 1960 (Grant)	Molecular Fragments in Shock Waves	51,698
Mellon Inst. of Industrial Research, Pittsburgh, Pa.	Dec., 1960	Nuclear MRS of Olefins & Alkanes	67,423
Penn State Univ., Univ. Park, Pa.	July, 1958	Reversibility of Radical-Olefin Reactions	14,639
Univ. of Mich., Ann Arbor, Mich.	June, 1959	Heterogeneous Catalysis	21,739
Univ. of Mass., Amherst, Mass.	Nov., 1960 (Grant)	Dynamic Birefringence of Polymeric Solids	50,400
Univ. of Pittsburgh, Pittsburgh, Pa.	Dec., 1960	Intermetallic Compounds Containing Lanthanides	56,958
Rensselaer Polytec. Inst., Troy, N. Y.	Dec., 1960	Structure & Properties of Molten Salts	66,000
Penn State Univ., Univ. Park, Pa.	Dec., 1960 (Grant)	Physical Properties of Isotopically Substituted Fluids	27,000
Kansas State Univ., Manhattan, Kans.	Feb., 1961 (Grant)	Crystallography of Solid Nitrogen Oxides	16,280
	INFORMATION COMPLEXES		
Jonker Business Machines, Inc., Gaithersburgh, Md.	Sept., 1960	Theoretical Study of Index Terminology	46,200
Battelle Memorial Institute, Columbus	Aug., 1958	Semiconductor Abstracts	5,750
Inst. of Aeronautical Sciences, New York, N. Y.	Jan., 1957	Review & Analysis of Aeronautical Research Information	18,264
Western Reserve Univ., Cleveland, Ohio	Jan., 1958	Theory of Documentation and Searching Strategy	34,437
Stanford Univ., Stanford, Calif.	Aug., 1960	Applications of Probability Theory to Problems in Scientific Methodology	9,359
Univ. of Mich., Ann Arbor, Mich.	Aug., 1958	Speech Analysis	36,000
	MATHEMATICAL SCIENCES		
Univ. of Va., Charlottesville, Va.	Aug., 1960	Topology & Mathematical Analysis	26,151
Case Inst. of Tech., Cleveland, Ohio.	Jan., 1958	Order Statistics in Sciences & Engineering	19,792
Mass. Inst. of Tech., Cambridge, Mass.	Aug., 1960	Mathematics of Quantum Field Theory	24,670
Wayne State Univ., Detroit, Mich.	Sept., 1960	Differential Geometry	8,438
Harvard College, Cambridge, Mass.	Aug., 1958	Algebraic Linear Systems	26,425
Syracuse Univ., Syracuse, N. Y.	Jan., 1959	Problems on Meromorphic Functions	6,225
Univ. of Minn., Minneapolis, Minn.	Feb., 1959	Ergodic & Renewal Theorems	4,524
Univ. of Mich., Ann Arbor, Mich.	Mar., 1959	Boundaries & Boundary Behavior	9,332
Univ. of Calif., Berkeley, Calif.	Feb., 1958	Studies in Transonic Flow	14,300
Univ. of Maryland, College Park, Md.	Jan., 1959	Elliptic Hyperbolic & Parabolic Partial Differential Equations	16,138
Univ. of Calif., Berkeley, Calif.	Feb., 1959	Algebraic Transformation Groups & Spaces	18,415
Johns Hopkins Univ., Baltimore, Md.	Sept., 1960	Partial Differential Equations	11,804
Case Inst. of Tech., Cleveland, Ohio	Sept., 1960	Abstract Sorting Algorithms	14,813
Univ. of Mich., Ann Arbor, Mich.	Oct., 1959	Topology and Modern Algebra	35,439
Polytechnic Inst. of Brooklyn, N. Y., N. Y.	Oct., 1960	Topological Solution of Differential Equations	12,745
Univ. of Illinois, Urbana, Ill.	Nov., 1958	Spaces Admitting Significant Fixed Point Indices	5,617
Wayne State Univ., Detroit, Mich.	Dec., 1956	Linear & Non-Linear Partial Differential Equations	1,950
Univ. of Oregon, Eugene, Oregon	Oct., 1960	Applications of Laplace Operators	4,853
Mass. Inst. of Tech., Cambridge, Mass.	Nov., 1956	Problems in Analytic Number Theory	27,249
Univ. of Miami, Coral Gables, Fla.	Jan., 1957	Functions of a Markov Process	5,644
Univ. of Missouri, Columbia, Mo.	Sept., 1959	Probability, Differential Equations & Calculus of Variations	9,014
Yale Univ., New Haven, Conn.	Oct., 1960 (Grant)	Certain Modern Algebras	26,557
Catholic Univ., Washington, D. C.	Oct., 1960 (Grant)	Probability Theory & Mathematical Statistics	13,898
State Univ. of Iowa, Iowa City, Iowa	Oct., 1960	Calculus of Variations & Boundary Value Problems	10,710
Penn State Univ., Univ. Park, Penn.	Dec., 1959	Singularity of Solutions of Linear Partial Differential Equations	10,036
Florida State Univ., Tallahassee, Fla.	Feb., 1959	Topology & Complex Analysis	9,658

(continued on p. 103)

KINETICS
CORPORATION
SOLANA BEACH, CALIF.

Kinetics motor-driven switch has connector reliability

The selfsame reliability and simplicity of the familiar connector has been built into the Kinetics motor-driven switch for missile and aircraft use. The principle of the switch is sound and straightforward—a small motor is used to engage the switch contacts in a manner similar to that of connector contacts. The positive mechanical action is more reliable than solenoid actuated devices under extreme environments. Because of the high contact pressure, the Kinetics' switch has successfully withstood more than 100 G's rms sinusoidal vibration without contact chatter. The captive contacts require no power to hold them in place once the switch has transferred.

The Kinetics' motor-driven switch features extremely low contact resistance. If arcing should occur, the arc is drawn away from the mating parts of the contacts. As a result, there is little or no change in internal resistance during the life of the switch.

Kinetics has achieved extremely high density construction through unique miniaturization capability. You get the most circuits in the least space. A 100-pole, double-throw switch measures only 5.1" x 2.7" x 3.2", and weighs only 5 lbs., yet each contact can carry up to 15 amps continuously. Some smaller models weigh just a few ounces and are smaller than a pack of cigarettes.

Kinetics switches are used on missiles for main power changeover, range safety systems, destruct circuits, telemetry applications, battery transfer and a host of other applications. They are now in use on virtually all of the major missile programs. For help with your switch requirements, write or phone Kinetics Corporation, Dept. KA-8, 410 South Cedros Avenue, Solana Beach, Calif. SKyline 5-1181.

Staff Positions:

ENGINEERING & ADMINISTRATION

Individuals seeking a creative environment in a growth company are encouraged to write or visit our facility in Solana Beach (San Diego County) Calif. Inquiries should be directed to Warren L. Smith, Staff Employment.

KINETICS
CORPORATION

ELECTRONICS · ELECTROMECHANICS

(continued from p. 101)

Univ. of Minnesota, Minneapolis	Jan., 1960	Riemann Surfaces	$ 4,261
Univ. of Minnesota, Minneapolis	Jan., 1960	Quasi-Conformal Mappings	4,284
Ohio State Univ., Columbus, Ohio	Oct., 1960	Non-Linear Oscillations	6,286
Marquette Univ., Milwaukee, Wis.	Nov., 1960 (Grant)	Applications of Continued Fractions to Mathematical Analysis	7,530
Cornell Univ., Ithaca, N. Y.	May, 1957	Statistical Multiple Decision Procedures	22,570
Stanford Univ., Stanford, Calif.	Dec., 1957	Functional Analysis & Algebraic Structures	14,709
Univ. of North Carolina, Chapel Hill, N. C.	Oct., 1960 (Grant)	Bounds for Characteristic Roots of Matrices	8,960
Univ. of Calif., Berkeley, Calif.	Nov., 1956	Modern Group Theory and Topology	28,665
Univ. of Oregon, Eugene, Ore.	Feb., 1960	Ordered Topological Lattices	12,579
Univ. of Penn., Univ. Park, Pa.	Nov., 1960	Topological Groups and Analysis	7,186
MECHANICS			
General Elec. Co., Philadelphia, Pa.	June, 1960	High Altitude Shock Wave Structure	49,560
Stanford Univ., Stanford, Calif.	Sept., 1960	Studies in Hypersonic Flow Theory	25,522
Rensselaer Polytech Inst., Troy, N. Y.	Sept., 1958	Continuous Forcing of an On-Off Control System	14,443
Columbia Univ., New York, N. Y.	Mar., 1958	Dynamic Behavior of Plates & Shells	28,000
Univ. of Toronto, Toronto, Can.	Aug., 1960 (Grant)	Transfer Systems in Free Molecule Flow	23,533
Rensselaer Polytech. Inst., Troy, N. Y.	Sept., 1960	Dynamics of Elastic Systems	32,600
Mass. Inst. of Tech., Cambridge, Mass.	Oct., 1960	Nonlinear Structural Problems of Flight Vehicles	29,750
Calif. Inst. of Tech., Pasadena, Calif.	July, 1958	Hypersonic Aerodynamics & Magnetohydrodynamics	29,600
Mass. Inst. of Tech., Cambridge, Mass.	June, 1957	Heat Transfer in Diffusion Boundary Layers	150,000
Univ. of New Mexico, Albuquerque, N. M.	Oct., 1960	Inelastic Behavior of Material by Dislocation Phenomenon	19,843
Gen. Applied Sci. Labs., Inc., N. Y.	Feb., 1957	Aerodynamics Noise	40,000
Rensselaer Polytech. Inst., Troy, N. Y.	Sept., 1960	Hypersonic Flow Phenomena	25,900
Univ. of Calif., Berkeley, Calif.	Aug., 1958	Arc Heated Low Density Wind Tunnel	12,000
Cornell Univ., Ithaca, N. Y.	Apr., 1959	Non Isentropic Gas Dynamics	32,988
Mass. Inst. of Tech., Cambridge, Mass.	Oct., 1959	Behavior of Metal Composites	49,725
NUCLEAR PHYSICS			
Florida State Univ., Tallahassee, Fla.	Mar., 1958	Nuclear Research Using a Tandem Van De Graaff Accelerator	271,781
Mass. Inst. of Tech., Cambridge, Mass.	May., 1960	Cosmic Ray Rsch of Showers Initiated by Primary Gamma-Rays	200,355
Univ. of Calif., Berkeley, Calif.	Jan., 1958	Theoretical Physics of Elementary Particles	40,000
Princeton Univ., Princeton, N. J.	Dec., 1959	Fundamental Concepts in Theoretical Physics	62,932
Univ. of Chicago, Chicago, Ill.	Sept., 1960	Quasi-Elastic Proton-Proton Scattering in Light Nuclei	98,000
Dartmouth College, Hanover, N. H.	Sept., 1960	Photoelectric Cross Sections at Energies Above I MEV	8,330
Yale Univ., New Haven, Conn.	Sept., 1960 (Grant)	Electron Nuclear Interactions	39,960
Univ. of Chicago, Chicago, Ill.	Apr., 1957	Nuclear Emulsion Studies of Hyperfragments	87,099
American Inst. of Physics, N. Y., N. Y.	Oct., 1960	Conference on Strong Interactions	5,750
Franklin Inst., Philadelphia, Pa.	Sept., 1958	Properties of Medium Weight Nuclei	32,500
Johns Hopkins Univ., Baltimore, Md.	June, 1956	Investigation of New Particles; Their Interactions and Properties	99,842
PHYSICS			
Univ. of Calif., Berkeley, Calif.	Sept., 1958	Magnetohydrodynamics	41,400
Johns Hopkins Univ., Baltimore, Md.	Nov., 1958	Spectra of the Triply Charged Rare Earth Ions	32,498
Smithsonian Inst., Washington, D. C.	Oct., 1955	Atmospheric Entry & Impact of High Velocity Meteorites	22,547
Univ. of Oklahoma, Norma, Okla.	Oct., 1956	Research on Optical Excitation Cross-Sections	29,828
Univ. of Calif., Berkeley, Calif.	June, 1955	Sampled Data Control Systems	28,000
Boston Univ., Boston, Mass.	Apr., 1959	Statistical Quantum Mechanics	10,551
Calif. Inst. of Tech., Pasadena, Calif.	Oct., 1960	Absolute Intensity Measurements and Gas Emissivities at Elevated Temperatures & Pressures	76,420
Univ. of So. Calif., Los Angeles, Calif.	Oct., 1958	Plasmas & Magnetohydrodynamics	26,080
Columbia Univ., New York, N. Y.	Dec., 1960	Properties of Atomic Ions	80,000
Columbia Univ., New York, N. Y.	Dec., 1960	Investigation in Control Systems	30,572
Aeronca Mfg., Corp., Baltimore, Md.	Dec., 1960	Optimal Control Theory	19,097
PROPULSION			
Rocket Power/Talco Div., The Gabriel Co., Pasadena, Calif.	Apr., 1960	Chemical Synthesis with Monoenergetic Ions	39,559
New York Univ., New York, N. Y.	Jan., 1957	Hydrodynamic Equations for a Free-Radical Flame	29,014
Univ., of Utah, Salt Lake City, Utah	Jan., 1957	Ignition and Burning of Solid Propellants	29,300
Univ. of Mich., Ann Arbor, Mich.	Jan., 1959	Stationary Gaseous Detonation Waves	61,566
Harvard Univ., Cambridge, Mass.	Oct., 1956	Combustion Dynamics	10,000
Calif. Inst. of Tech., Pasadena, Calif.	Sept., 1959	Growth of Boundary Layers in Plasma Accelerators	133,899
Aerojet-Gen. Corp., Azusa, Calif.	Apr., 1956	Kinetics of Energetic Species at Low Temperatures	77,768
Purdue Research Found., Lafayette, Ind.	Sept., 1959	Experimental Investigation of Transverse Combustion	94,710
New York Univ., New York, N. Y.	Sept., 1960	Criteria of Inflammability Limits	8,957
Plasmadyne Corp., Santa Ana, Calif.	Oct., 1959	High Intensity Plasma Jets	19,345
Princeton Univ., Princeton, N. J.	Sept., 1960	Propellant Ignition & Igniter Characteristics	40,000
Republic Aviation Corp., Farmingdale	Dec., 1958	Electromagnetical Chemical Reactions	151,100
Gen. Applied Sci. Labs., Inc., L. I., N. Y.	Oct., 1960	Hypersonic Combustion	94,567
Inst. of Aerospace Sciences, Inc., New York, N. Y.	Dec., 1960 (Grant)	Aerospace Symposium Operated in Honor of Dr. Theodore Von Karman	35,426
Avco Corp., Everett, Mass.	Nov., 1956	Studies in Magnetohydrodynamics	298,410
SOLID STATE SCIENCES			
Univ. of Florida, Gainsville, Fla.	Sept., 1960	Electron Excitations in Superconductors	31,342
Rutgers Univ., New Brunswick, N. J.	Sept., 1956	Early Detection of Fatigue of Metals	46,398
Penn State Univ., University Park, Pa.	Sept., 1960	Phase Equilibria Reaction Mechanisms	47,300
Univ. of Mich., Ann Arbor, Mich.	Oct., 1960	Electromagnetic Radiations in Crystals	93,800
Univ. of Mich., Ann Arbor, Mich.	Oct., 1960	Magnetic & Electric Phenomena in Ferrimagnetics	70,000
Syracuse Univ., Syracuse, N. Y.	Mar., 1959	Theory of Vibration Spectra	32,163
Gen. Elec. Co., Schenectady, N. Y.	Nov., 1960	Semi-Conducting Compounds Conf.	9,850
Battelle Memorial Inst., Columbus	Sept., 1960	Zinc Blende Type Semi-Conductors	120,000
Penn State Univ., Univ. Park, Pa.	Sept., 1958	Field Emission Studies of Surfaces	15,129
Cornell Univ., Ithaca, N. Y.	Sept., 1959	Studies of the Surface of Solids	10,854
Univ. of No. Dakota, Grand Forks, N. D.	Nov., 1960 (Grant)	Residual Stresses Around Impurities in Solids	12,945
Virginia Inst. for Science Research, Richmond, Va.	Nov., 1960 (Grant)	Growth & Perfection of Single Crystals	29,956

New Offerings

Arcs Industries, Inc., Huntington Station, N. Y., engaged primarily in the manufacture of electronic, electrical, electromechanical and mechanical components, subassemblies, assemblies and special devices for use in the missile and computer fields. Offering is $1,630,000 of 6% convertible subordinated debentures, due 1971, for subscription at 100% of principal amount by common stockholders at the rate of $500 of debentures for each 100 shares held; record date to be supplied by amendment. Proceeds will be used to repay bank loans incurred to purchase real estate and other assets now used in connection with operation of Machinery Builders, Inc., a subsidiary engaged in the precision machining of component parts of aircraft and missile engines; to buy a building in Huntington; to provide additional working capital; balance will be used as additional working capital.

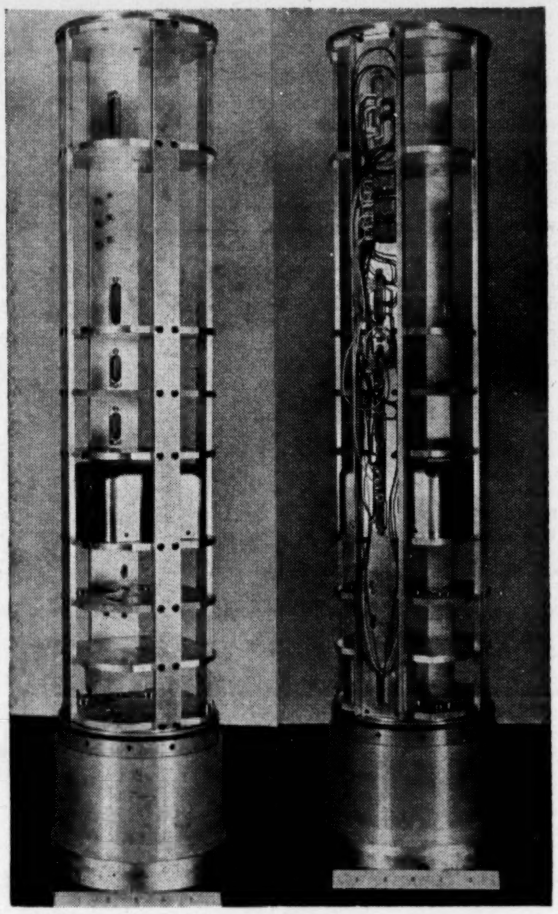
American Electronic Laboratories, Inc., Philadelphia, Pa., engaged primarily in research and development in the field of electronic communication equipment; it also produces and sells on a commercial basis various electronic equipment and components. Offering is 10,632 shares of Class A common stock, for subscription by stockholders at the rate of one new share for each 10 shares held; record date and offering price to be supplied by amendment. Offering also includes 23,100 Class A common shares to be offered to officers and employes for the company to whom stock options have been or will be granted under its Stock Option Plan. The company is presently engaged in constructing additional facilities at its Lansdale site; of the proceeds, $150,000 will be used to finance such construction. The company plans to apply $100,000 to purchase additional equipment for use in the new plant; the balance, if any, will be used for general corporate purposes.

Andersen Laboratories, Inc., West Hartford, Conn., engaged in the design, manufacture and sale of high precision delay lines which act as data storage elements in various circuits. Offering is 34,750 outstanding shares of common stock. The shares are held by The Bank of Bermula, Ltd., as trustee of five trusts, and the bank proposes to offer such shares for sale from time to time in the over-the-counter market at prevailing prices thereon.

Rowan Controller Co., Baltimore, Md., engaged in the manufacture and sale of industrial controls, electromechanical devices such as relays and contractors, push button and pilot devices, thermal and magnetic circuit protectors, military and commercial panel meters, transistor meters and other electronic instruments. Offering is 50,000 shares of common stock, for public sale on an all or none basis; public offering price and underwriting terms to be supplied by amendment. Proceeds, together with other funds of the company, will be applied to the cost of expanding its business through the development of new and improved products, and to the retirement of its long-term debt. The company intends to apply $157,500 to the retirement of a 5½% long-term loan and $180,000 to the further development of the line of circuit protectors marketed by the company; the remainder will be used for general corporate purposes.

Radiation Instrument Development Laboratory, Inc., Northlake, Ill. (organized under Illinois law in 1957 and reorganized under Delaware law in May, 1961), principally engaged in the development, design and production of electronic instruments and systems for the detection, measurement and analysis of nuclear or atomic radiations. Offering is 100,000 shares of common stock; 86,666 shares for public sale by the company, and 13,334 outstanding shares by the present holders thereof. Public offering price and underwriting terms to be supplied by amendment. Proceeds from the company's sale will be added to general funds for working capital purposes, increased research and development expenditures and anticipated expenses in connection with the leasing of additional plant facilities. Of such amount, $150,000 will be used for the payment of current bank borrowings which were incurred to supplement working capital.

Ets-Hokin & Galvan, Inc., San Francisco, Calif., engaged in installing electrical and electronic systems in missile production facilities and in missile and satellite base installations, including ground support systems for testing and operational sites, as well as communications systems and tracking systems for missiles and satellites. Offering is 209,355 shares of common stock; 100,000 shares for public sale by the company, and 109,355 outstanding shares by the present holders thereof. The offering will be made on an all or none basis; public offering price and underwriting terms to be supplied by amendment. Proceeds from the company's sale will be added to funds of the company to be used for general corporate purposes, principally for working capital. The company anticipates that substantially all of the proceeds will be applied initially to the reduction of short-term loans payable to a bank, which loans were used for working capital purposes.



Instrument Rack Shown

Standardized instrumentation rack for upper atmosphere sounding rockets, developed by Geophysics Corp. of America, can accommodate equipment payloads of variable size and configuration and can withstand severe vibration and shock conditions.

Tresco, Inc., Philadelphia, Pa., engaged in the manufacture and sale of specially designed and engineered transformers and inductors which are used as components for various types of electronic equipment. Offering is 100,000 shares of common stock, for public sale at $5 per share. Proceeds will be used to reduce existing bank loans; for research and development costs necessary to produce new items currently under development; to finance initial operations of a subsidiary; the balance for general corporate purposes.

Federal Tool and Manufacturing Co., Minneapolis, Minn., engaged primarily in the manufacture and sale of short-run stampings out of such metals as sheet strip steel, sheet aluminum, brass, copper, bronze, nickel, beryllium, stainless steels and aircraft alloys, and such non-metals as phenolics, nylon and fiber. Offering is 300,000 outstanding shares of common stock by the holders thereof, for public sale at $5 per share.

Cosmodyne Corp., Hawthorne, Calif.; the company and two wholly-owned subsidiaries are principally engaged in the design, development, manufacture, sale and leasing of specialized equipment for the storage, transportation and pumping of cryogenic liquids and gases. Offering is 100,000 shares of common stock for public sale; public offering price and underwriting terms to be supplied by amendment. Proceeds will be used to finance the manufacture of cryogenic equipment for lease to customers; to purchase manufacturing and processing equipment; of the balance, a portion will be used to reduce recent bank borrowings and the remainder will be added to general funds to meet costs of new product development and for additional working capital.

Polarad Electronics Corp., Long Island City, N. Y., engaged in the design and manufacture of microwave test instruments; it is also engaged in a number of defense production contracts and defense research and development contracts with respect to electronic counter-measure equipment, communication equipment, precise navigation instruments, and ground control and test equipment for guided missiles and other advanced military systems. Offering is 37,000 shares of common stock which have been or will be issued in exchange for all the issued and outstanding stock of Federal Scientific Corp., New York City, which shares may be sold by the recipients at prices based upon current prices to or through dealers in the over-the-counter market or on any national securities exchange or otherwise (32,000 shares have been so issued and an additional 5,000 may be issued). Federal is engaged under military contracts and subcontracts in work relating to coherent and pulse radar systems, long-range detection, information theory, and FM and continuous wave exciters.

Edo Corp., College Point, N. Y.; the company and its subsidiaries are engaged in the design, development and manufacture of a variety of items of electronic and electrical equipment and components, specializing in marine (both surface and undersea) and airborne devices, and in the design, development and manufacture of specialized sheet metal products for use in ships, submarines and aircraft. Offering is 108,971 outstanding shares of common stock, for public sale by the holders thereof; offering price and terms to be supplied by amendment.

Texas Capital Corp., Georgetown, Tex.; organized in October, 1958, it is engaged in the business of investing in small business concerns through the purchase of their convertible debentures and by making long-term loans to such concerns. Offering is 1,000,000 shares of common for public sale; public offering price and underwriting terms to be supplied by amendment. Proceeds will be used to provide investment capital to enable it to make additional loans and furnish additional managerial services to small business concerns.

Aerospace Industry Salaries Are Reported

Washington–Following is a list of aerospace industry directors and officers with 1960 salaries above $30,000 and their stockholdings, as reported to the Securities and Exchange Commission:

Avco Corp.—V. Emanuel, chairman (deceased), $175,000 salary; **K. R. Wilson, Jr.**, chairman, member of the executive committee and director, $140,000 salary, 17,000 shares of common stock, $4,000 convertible debentures; **J. R. Kerr**, president, member of the executive committee and director, $115,000 salary, 9,334 shares of common stock, $2,000 convertible debentures; **E. H. Blaik**, chairman of the executive committee and director, $110,000 salary, 1,000 shares of common stock; **M. A. McLaughlin**, vice president, general counsel, director and member of the executive committee, $100,000 salary, 6,000 shares of common stock, $2,000 convertible debentures; **A. R. Kantrowitz**, vice president and director, $96,615 salary, 8,500 shares of common stock; **J. D. Shouse**, vice president and director, $87,500 salary, 16,980 shares of common stock; **W. A. Morgensen**, director, $35,000 salary, 6,000 shares of common stock; **G. E. Allen**, director and member of the executive committee, 2,500 shares of common stock, $3,900 convertible debentures; **I. B. Babcock**, director, 2,151 shares of common stock, $3,300 convertible debentures; **J. Bruce**, director, 3,000 shares of common stock, **M. W. Clement**, director and member of the executive committee, 1,050 shares of common stock, $2,000 convertible debentures; **C. C. Darling**, director, 6,000 shares of common stock, $10,000 convertible debentures; **R. H. Deetjen**, director, 2,500 shares of common stock, $5,000 convertible debentures; **R. L. Johnson**, director, 900 shares of common stock, $1,000 convertible debentures; **H. H. Kahn**, director, 2,500 shares of common stock; **E. H. Litchfield**, director, 1,500 shares of common stock; **M. A. MacIntyre**, director (since 1960), 1,000 shares of common stock; **J. A. McDougald**, director, 10,000 shares of common stock;. **W. I. Myers**, director and member of the executive committee, 1,000 shares of common stock; **B. H. Namm**, director, 3,306 shares of common stock; salaries are listed for the fiscal year ending Nov. 30, 1960; stocks are listed as of Jan. 30, 1961.

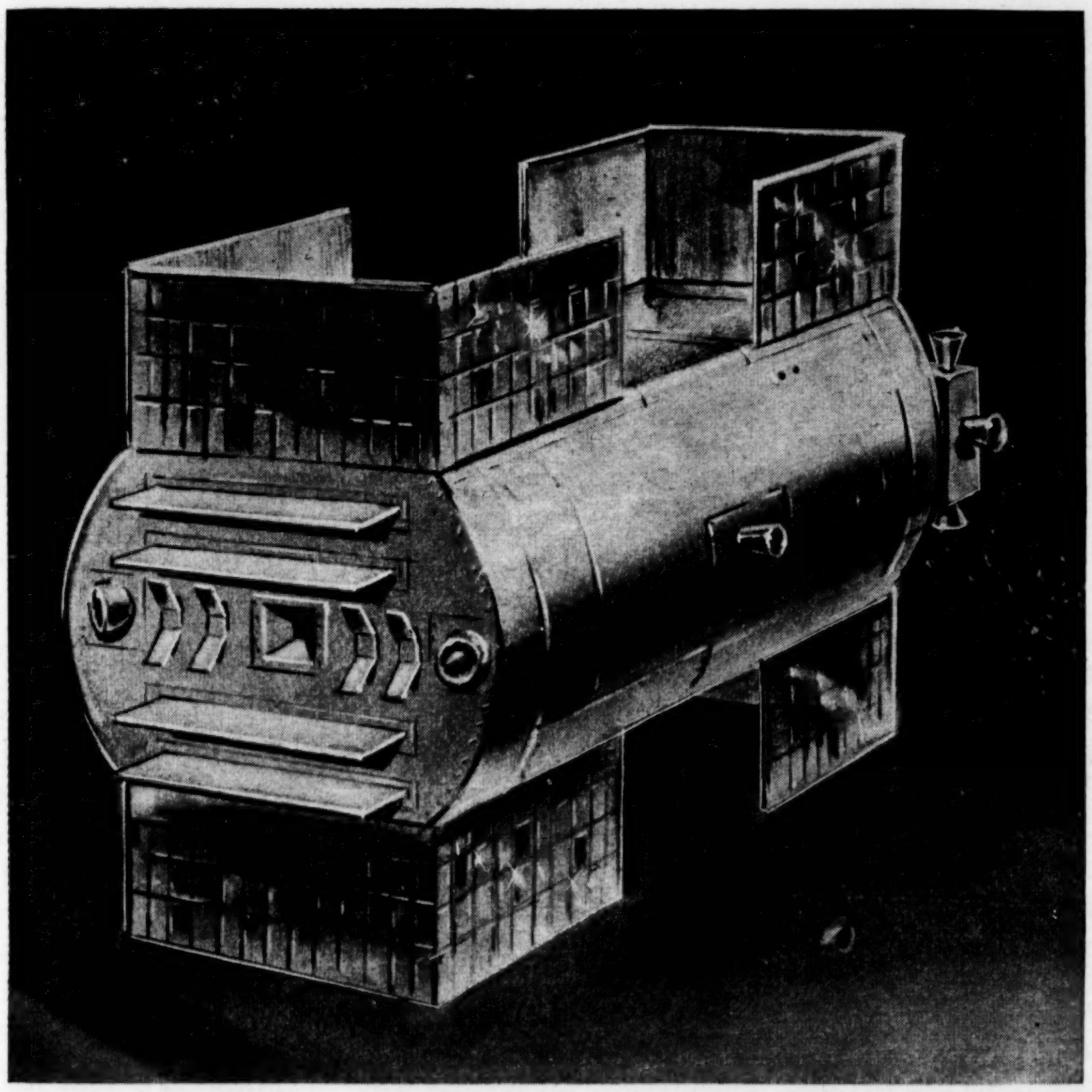
Aerojet-General Corp.—D. A. Kimball, president, member of executive committee and director, $95,000 salary, 215 shares of common stock, 6,029 shares of common stock in **General Tire & Rubber Co.**, which controls Aerojet; **A. H. Rude**, executive vice president, member of the executive committee and director, $80,000 salary, no stock, 2,501 shares of **General Tire & Rubber Co.** common stock; **W. E. Zisch**, vice president, general manager and director, $80,000 salary, no stock, 1,138 shares of **General Tire & Rubber Co.** common stock; **R. I. McKenzie**, treasurer, assistant secretary and director (since July 6. 1960), $53,800 salary, no stock, 1,556 shares of **General Tire & Rubber Co.** common stock; **T. E. Beehan**, secretary, $35,400 salary, no stock, 1,682 shares of **General Tire & Rubber Co.** common stock; **M. G. O'Neil**, director, no stock, 90,971 shares of **General Tire & Rubber Co.** common stock; **L. A. McQueen**, director, no stock, 13,683 shares of **General Tire & Rubber Co.** common stock; **F. W. Knowlton**, director, no stock, 1,626 shares of **General Tire & Rubber Co.**, common stock; **T. M. Conroy**, director, no stock; **G. E. Smith**, director, 72 shares of common stock. Stocks are listed as of Jan. 1, 1961.

Chance Vought Corp.—C. J. McCarthy, chairman, (retired Nov. 1, 1960) $46,466 salary; **F. O. Detweiler**, president and director, $91,400 salary; **H. B. Sallada**, senior vice president and director (retired Feb. 1, 1960), $20,033 salary; **G. K. Johnson**, executive vice president and director, $64,499 salary, 1,600 shares of common stock; **F. E. Burnham**, vice president-finance, $54,469 salary; **R. C. Blaylock**, vice president and director, $58,500 salary, 250 shares of common stock; **C. E. Burt**, vice president and director, $51,900 salary, no stock; **W. P. Thayer**, vice president and director (since 1960), $47,800 salary.

Daystrom—T. R. Jones, chairman, $84,700 salary, 16,460 shares of common stock; **B. T. Blauvelt**, vice president-finance and director, $51,800 salary, 5,000 shares of common stock; **T. Allinson**, vice president, $42,500 salary; **F. J. Andre**, director, 100 shares of common stock; **L. M. Cassidy**, director, 102 shares of common stock; **R. G. Cowan**, director, 200 shares of common stock; **C. S. Lutkins**, director, 510 shares of common stock; **E. R. Mellen**, director, 3,536 shares of common stock; **J. B. Montgomery**, director, 380 shares of common stock; **C. S. Proctor**, director, 600 shares of common stock; **C. F. Smith**, director, 100 shares of common stock; **L. W. Trayser**, director, 110 shares of common stock; **E. G. Williams**, director, 551 shares of common. Salaries are for fiscal year ending Mar. 31, 1961; stocks are listed as of May 1, 1961.

Douglas Aircraft Co.—G. E. Donovan, vice president and director, $46,738 salary, 400 shares of capital stock; **D. W. Douglas**, chairman, and chief executive officer, $127,362 salary, 10,150 shares of capital stock; **D. W. Douglas, Jr.**, president and director, $87,675 salary, 1,082 shares of capital stock; **J. A. Dundas**, executive vice president and director, $56,675 salary, 824 shares of capital stock; **I. C. Eaker**, vice president and director, $40,800 salary, 500 shares of capital stock; **N. Paschall**, commercial sales adviser and director (resigned Jan. 18, 1961), $34,500 salary; **A. E. Raymond**, senior vice president and director, (retired as director Apr. 20, 1960 and as senior vice president June 1, 1960), $35,689 salary; **C. R. Able**, vice president-defense programs and director, 100 shares of capital stock; **M. W. Bekins**, director, 618 shares of capital stock; **F. W. Conant**, director, 1,122 shares of capital stock; **L. de Florez**, director, 412 shares of capital stock; **K. G. Farrar**, vice president-manufacturing and director (since 1960), 109 shares of capital stock; **C. S. Jones**, director; **G. Mayo**, director; **J. R. McGowen**, vice president-commercial programs and director, 108 shares of capital stock; **E. H. McLaughlin**, director, 400 shares of capital stock; **N. Petree**, director, 154 shares of capital stock; **G. Romney**, director (since 1960), 200 shares of capital stock, **D. Whiting**, director, 1,000 shares of capital stock. Salaries are listed for the fiscal year ending Nov. 30, 1960; stocks are listed as of Mar. 3, 1961.

General Dynamics Corp.—F. Pace, Jr., chairman, $152,000 salary, 30,500 shares of common stock; **H. Crown**, chairman-Material Service Division and director (director since 1960), $48,300 salary, 192,951 shares of preferred stock; **W. P. Gullander**, executive vice president and director, $67,500 salary; **E. D. Johnson**, president and director, $137,000 salary, 3,500 shares of common stock; **C. R. MacBride**, executive vice president and director, $91,875 salary; **J. T. McNarney**, consultant and director, $33,101 salary, 10,513 shares of common



High-Altitude Active Repeater Satellite Foreseen

Lockheed artist's conception of what an active repeater satellite for high-altitude synchronous equatorial orbit might look like has boxlike arrays of solar cells top and bottom. This type of controlled-attitude satellite would be designed to orbit 22,300 mi. above a fixed point of the Atlantic Ocean at the equator and to serve as a communications relay. Lockheed suggests that the satellite might be orbited by a Convair Atlas-Lockheed Agena vehicle.

On September 25, AVIATION WEEK and Space Technology will publish one of the most important issues in its history . . . "FORGING MILITARY SPACEPOWER" – USAF SYSTEMS COMMAND ISSUE. For the first time, the complete story of the newly activated USAF Systems Command will be presented to the aerospace industry throughout the world.

The new Systems Command will serve as a single agency to control R&D and procurement of all aircraft, missile, avionic and space systems for the USAF from the idea stage through the time they are in the field ready for use. This concept of a single agency for both systems R&D and systems procurement will have penetrating impact on all aerospace industry companies selling hardware or research services to the Air Force.

The Systems Command will control approximately $15 billion in contracts and annually will award $7-8 billion in new contracts making it the most important single source of aerospace industry business. Further evidence of the impact on industry are policy and procedure changes which can be expected in many areas such as technical approach, contract competition, proposals, cost estimating, management structure and subcontracting.

These are just a few of the important details to be covered in the Systems Command Issue, which will constitute a new handbook in doing business with the Air Force. Teams of AVIATION WEEK editors are now visiting the various bases of the Command for full, complete reports. Detailed edi-

G MILITARY SPACEPOWER”

USAF SYSTEMS COMMAND ISSUE

SEPTEMBER 25, 1961

torial coverage will be given to procurement, organization, plans and programs, policies, procedures and future technical activities.

AVIATION WEEK is privileged to present this edition to the industry covering our newest and vitally important Command. Prime contractors, subcontractors, suppliers and firms doing R&D work for the Air Force will be extremely interested in this new issue which will lay the groundwork for future contacts with the Command. It will supersede all previous editions on USAF research, development and procurement policies.

Your company is urged to participate by advertising its capabilities and facilities for the furtherance of the defense effort. Write, wire or call collect for space reservations.

Aviation Week
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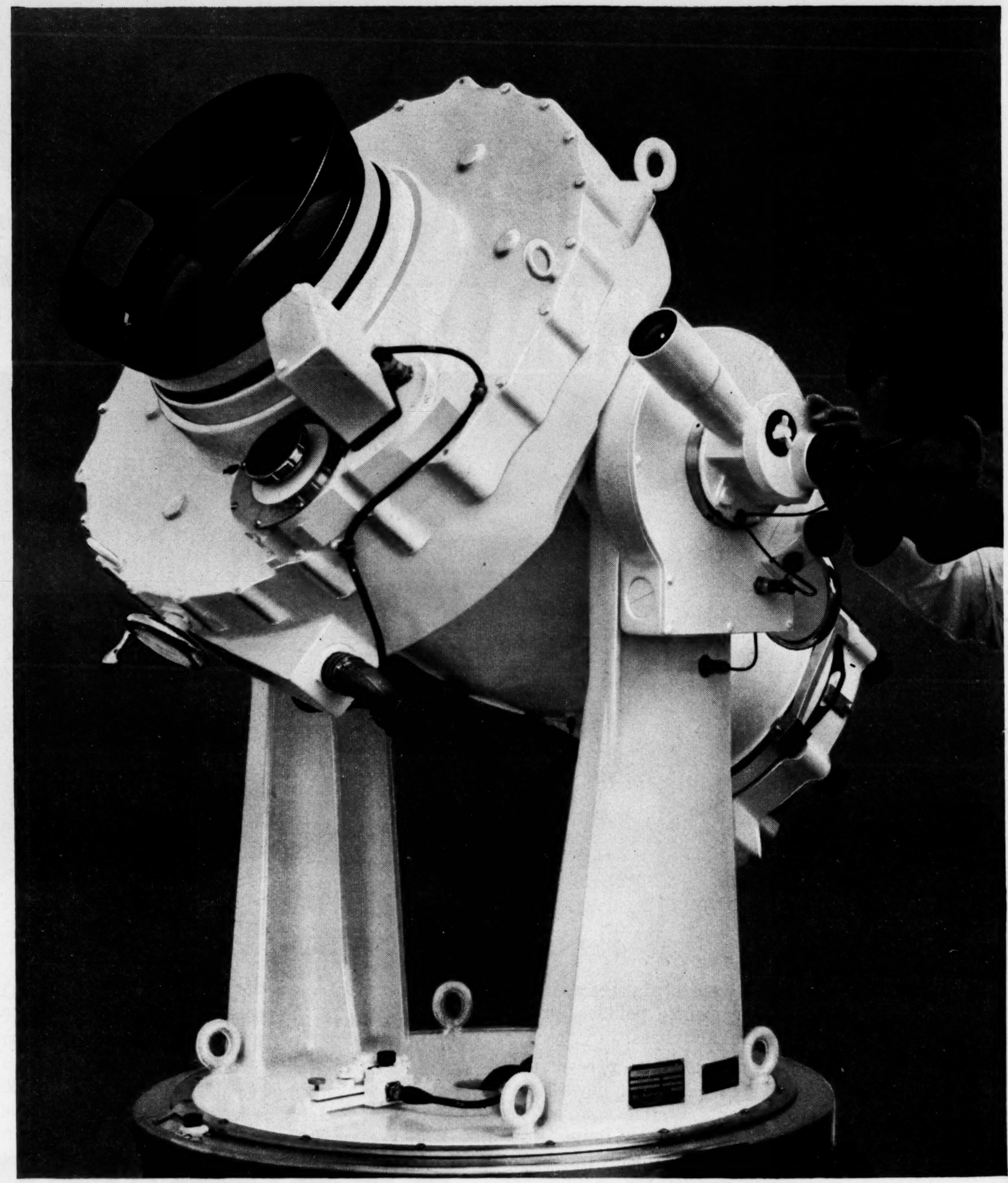


This camera watches the birdie

This is a ballistic camera, designed to photograph a missile in flight, and check its trajectory against a precise background of stars to detect the slightest deviation from course. It is the largest accurate ballistic camera ever built. Its 8-element, 600-mm, f/2 lens has an accuracy of 1 part in 200,000. Though the shutter is 12 inches in diameter, it opens and closes in 2 milliseconds. The entire instrument, including its unique lens and shutter, was designed and manufactured by Nortronics.

NORTRONICS
A DIVISION OF
NORTHROP

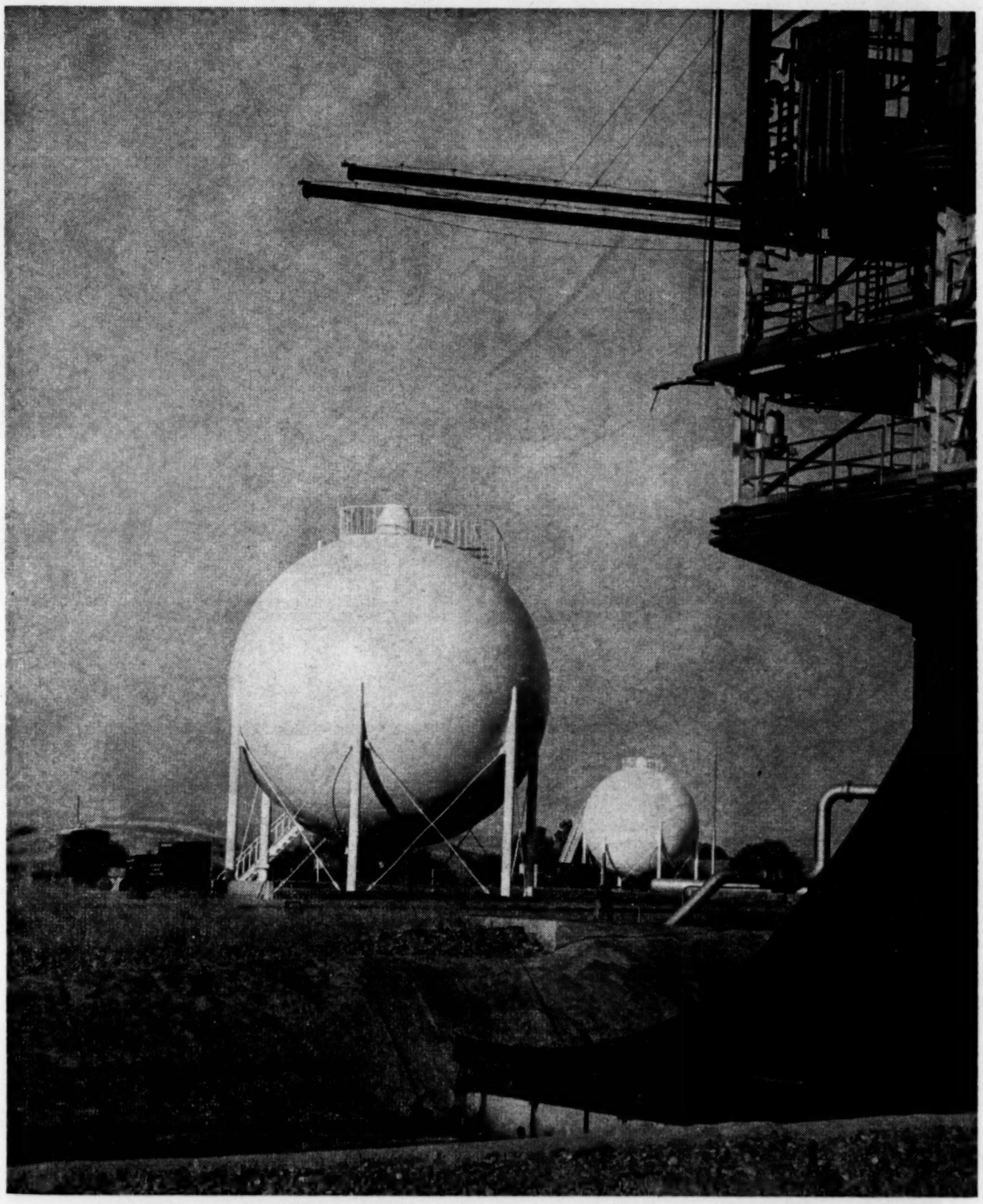
stock; **J. G. Notman**, senior vice president, and president of Canadair, Ltd., $93,250 (Canadian) salary; **W. M. Blair**, director, 3,700 shares of common stock; **S. C. Coleman**, director, 300 shares of common stock; **W. P. Dixon**, director, 500 shares of common stock; **B. E. Finucane**, director, 1,500 shares of common stock owned by a family corporation in which Finucane is a stockholder; **E. C. Alvord**, director, 5,495 shares of common stock and 14,568 shares of common stock owned by a corporation in which Alvord is a stockholder; **I. M. Laddon**, director, 407 shares of common stock; **O. Marx**, director, three shares of common stock and 3,150 shares of common stock owned by a corporation in which Marx is a stockholder; **D. N. McDonnell**, director, 171 shares of common stock; **C. M. Miller**, director, 14,000 shares of common stock; **R. C. Patterson, Jr.**, director; **D. Richardson**, director, 100 shares of common stock; **R. F. Windfohr**, director, 6,000 shares of common stock. **H. A. Anderson**, director (since 1960); **J. R. Miller**, director (since 1960); **F. G. Sherrill**, director (since 1960). Stocks are listed as of Feb. 1, 1961.

Lockheed Aircraft Corp.—C. A. Barker, Jr., consultant and director, $31,800 salary, $23,800 incentive payments for prior years, $21,384 retirement benefits, 2,101 shares of capital stock; **D. E. Browne**, vice president-finance and director, $65,000 salary, $13,933 incentive payments for prior years, 7,845 shares of capital stock; **C. Chappellet**, senior vice president and director, $78,688 salary, $17,800 incentive payments for prior years, 27,242 shares of capital stock; **C. S. Gross**, president and director, $100,000 salary, $22,600 incentive payments for prior years, 32,425 shares of capital stock; **R. E. Gross**, chairman and chief executive officer, $125,928 salary, $36,200 incentive payments for prior years, 158,600 shares of capital stock; **D. J. Haughton**, executive vice president and director, $85,000 salary, $18,333 incentive payments for prior years, 9,324 shares of capital stock; **H. L. Hibbard**, senior vice president and director, $78,688 salary, $17,800 incentive payments for prior years, 9,444 shares of capital stock; **H. W. McCurdy**, director, $52,596 salary, 22,293 shares of capital stock; **G. Brashears**, consultant and director, 100 shares of capital stock; **W. A. M. Burden**, director; **J. V. Carmichael**, director; **E. S. Dulin**, director, 510 shares of capital stock; **H. L. Dunn**, director, 610 shares of capital stock; **W. W. Keith**, director, 1,224 shares of capital stock; **C. B. Squier**, consultant and director, $18,630 retirement benefits, 5,100 shares of capital stock. Salaries are listed for the fiscal year ending Dec. 25, 1960; stocks are listed as of Mar. 1, 1961.

Sperry Rand Corp.—D. L. Bibby, executive vice president, director and president of Remington Rand, $93,750 salary, 1,100 shares of common stock; **N. B. Frost**, director, and general counsel, $40,000 salary, 9,443 shares of common stock; **K. R. Herman**, executive vice president and director, $137,500 salary, 27,846 shares of common stock; **C. G. Holschuh**, executive vice president and director, $124,000 salary, 7,875 shares of common stock; **H. Landsiedel**, director and vice president of Remington Rand, $63,600 salary, 6,160 shares of common stock; **D. MacArthur**, chairman, $68,600 salary, 1,795 shares of common stock; **H. F. Vickers**, president, chief executive officer and director, $225,000 salary, 150,925 shares of common stock; **I. J. Harvey**, director, 1,020 shares of common stock; **B. F. Pope**, director, 415 shares of common stock. Salaries are listed for the fiscal year ending Mar. 31, 1961; stocks are listed as of May 8, 1961.

Thiokol Chemical Corp.—J. W. Crosby, president and director, $67,500 salary, 48,456 shares of common stock; **H. R. Ferguson**, executive vice president and director, $49,000 salary, 28,662 shares of common stock; **J. S. Jorczak**, vice president and director, $31,250 salary, 5,940 shares of common stock; **S. M. Martin, Jr.**, vice president and director, $36,500 salary, 23,059 shares of common stock; **A. Raws, Jr.**, treasurer $31,500 salary; **H. W. Ritchey**, vice president and director, $43,000 salary, 7,014 shares of common stock; **J. E. Hughes**, director, 105 shares of common stock; **R. Lang**, director, 290,595 shares of common stock; **C. S. Lutkins**, 2,295 shares of common stock; **C. S. Proctor**, director, 2,846 shares of common stock; **O. L. Schweng**, director; **D. N. Sosland**, director, 444 shares of common stock and 130,999 shares of common stock owned by three partnerships in which Sosland is a partner; **W. M. Spencer**, director, 3,065 shares of common stock; **C. B. Vose**, director, 43,194 shares of common stock; **T. F. Walkowicz**, director. Stocks are listed as of Feb. 14, 1961.

Hiller Realization Corp. (formerly Hiller Aircraft Corp.)—**S. Hiller, Jr.**, president and director, 101,183 shares of common stock; **W. A. Blees**, sales manager-Adhesive Division and director, 52 shares of common stock; **E. T. Bolton**, executive vice president, general manager and director, 210 shares of common stock; **F. A. Callery**, director, 1,680 shares of common stock; **A. J. M. Chadwick**, vice president and director, 105 shares of common stock; **K. Ferguson**, secretary and director, 1,438 shares of common stock; **P. M. Hamilton**, director, 105 shares of common stock; **F. A. Heileman**, director of advanced research and director, 364 shares of common stock; **S. Hiller, Sr.**, director, 8,460 shares of common stock; **M. E. McAlpin**, director, 1,275 shares of common stock—McAlpin is trustee of a trust holding 12,750 shares of common stock in which he has a beneficial interest; **H. L. McIntyre**, director, 1,050 shares of common stock; **L. B. Richardson**, director, 195 shares of common stock; **A. W. B. Vincent**, vice president and director, 14,845 shares of common stock. Stocks are listed as of Jan. 6, 1961.



Saturn Liquid Hydrogen Tanks Installed

Spherical liquid hydrogen tanks for NASA Saturn S-IV stage test stand have been installed at the Douglas Aircraft Co. Sacramento, Calif. test facility. Test stands for the Douglas Thor IRBM are being converted to test the S-IV stage which will be powered by six Pratt & Whitney LR-115 engines burning liquid hydrogen and liquid oxygen. The two 35-ft diameter storage vessels hold 90,000 gal. each. The tanks are of a double-wall design intended to prevent conduction of atmospheric warmth to the cryogenic fuel. The 2.5-ft. gap between the inner and outer wall of each tank is filled with 60,000 lb. of expanded volcanic silicate insulation. Air is evacuated from the inter-wall space. Temperature spread between the inside and outside of the tank will often be more than 500F but Douglas engineers say the tank design will hold hydrogen loss by evaporation to 0.13% per day. Tanks were assembled on-site by Chicago Bridge & Iron Co. After tanks have been pressurized to 80 psi. with gaseous hydrogen, liquid hydrogen will be pumped in through vacuum-jacketed transfer lines at 2,000 gal. per min. Douglas is prime contractor for the S-IV which is to be the second stage of the Saturn C-1 booster system.

INTRODUCING THE NEWEST ASHLESS DISPERSANT OIL THAT'S BEEN FLIGHT-TESTED FOR OVER 15 MILLION ENGINE MILES!

ESSO AVIATION OIL E

Extensive flight tests by airlines and private pilots prove that this new ashless dispersant engine oil helps keep engines clean . . . thus reducing wear and oil consumption. In addition, because its additives are ashless, Esso Aviation Oil E does not induce spark plug fouling. As a result of the unusually high performance characteristics of this new oil, only two grades are needed to provide the full viscosity range for piston engines in all seasons. New Esso Aviation Oil E has been cleared for use by every major U. S. aircraft engine manufacturer. For further information, see your nearest Esso Aviation Dealer or write to us at 15 W. 51st Street, New York 19, New York.

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XB-HAA

LOCKHEED INTERNATIONAL'S 60, an all metal, high-wing monoplane, can be adapted for aerial ambulance or agricultural work.

Alaska Airlines to Use, Sell Lockheed 60s

By Arnold Sherman

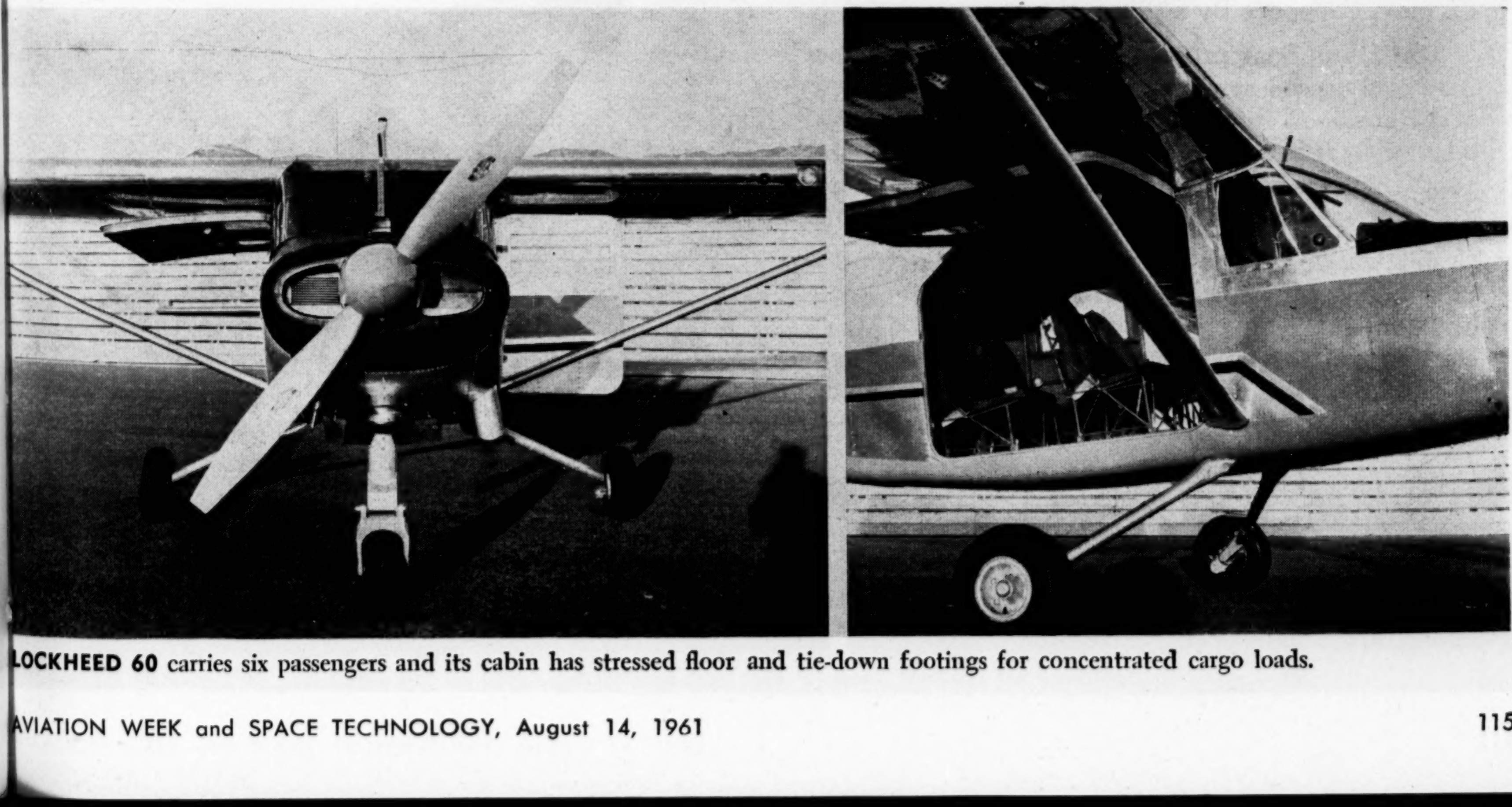
Alaska Airlines has become the first U. S. sales representative for the Lockheed 60 bush lightplane. The Alaskan carrier, serving Portland, Seattle-Tacoma, Fairbanks, Anchorage, Nome, Kotzebue and intermediate stops, is now the exclusive dealer for the six-passenger aircraft (AW July 4, 1960, p. 88), in the State of Washington and Alaska.

Simultaneously the airline placed an order for five of the planes which, in addition to being used as demonstrators, will be integrated into the following airline operations:

- **Serving Alaska Airlines'** four-times-a-day passenger, cargo and mail run from Fairbanks to the Ballistic Missile Early Warning Station at Clear, Alaska (AW July 24, p. 84).
- **Carrying hunting tours** to Kotzebue, a polar bear hunting area in north-northwestern Alaska.
- **Acting as the basic aircraft** for an FAA-approved training program now being established at Seattle, Fairbanks and Anchorage for airline and air taxi operators.

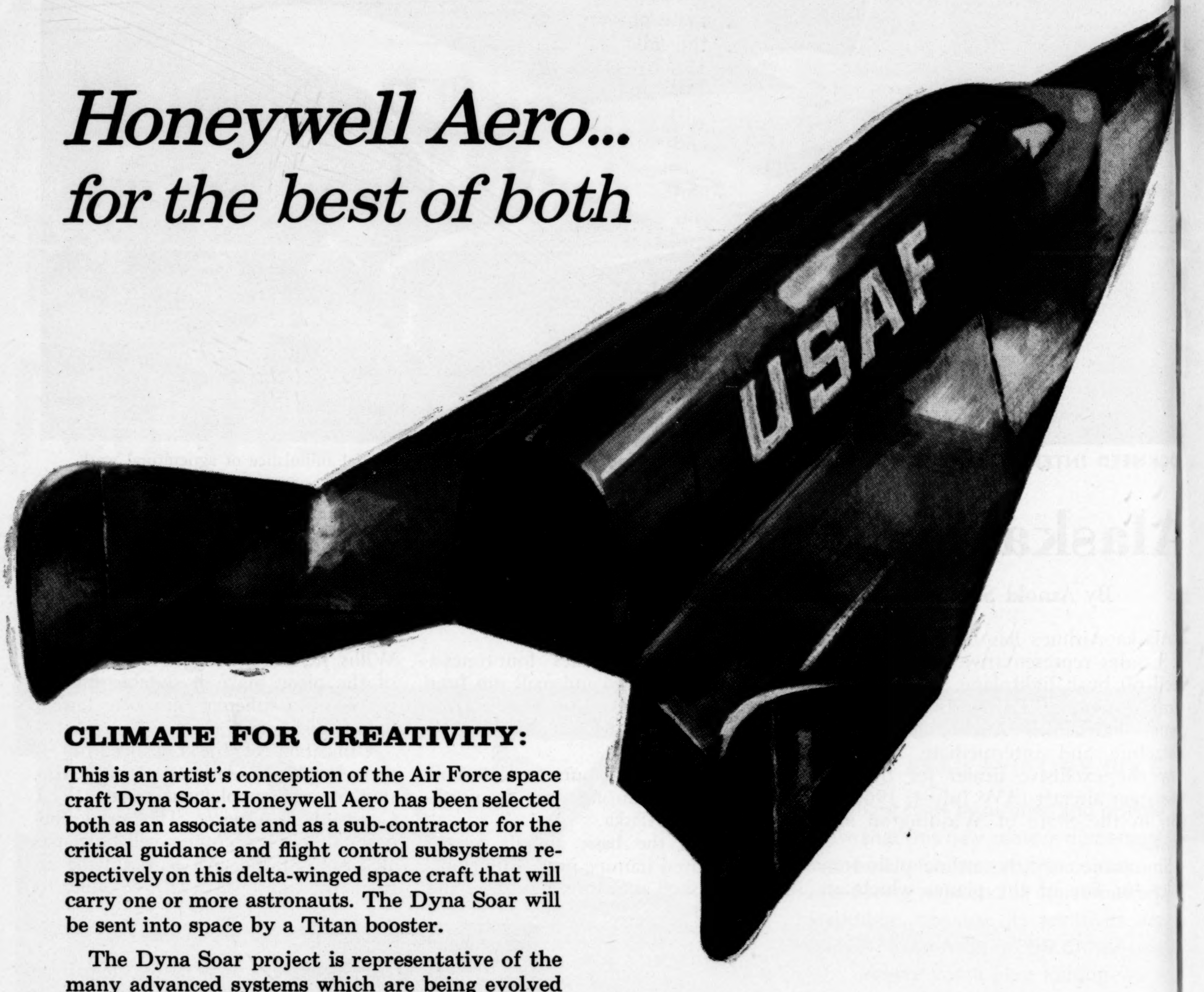
Alaska Airlines' President Charles F. Willis, Jr., said the rugged characteristics of the plane make it suitable for the peculiarities inherent in polar terrain flying operations.

Utilization of the Lockheed 60 is seen by Alaska Airlines as an extension of, and supplement to, its West Coast/Alaska service. The airline believes that extra business will be generated from Seattle since parties flying up from the northwest will be able to



LOCKHEED 60 carries six passengers and its cabin has stressed floor and tie-down footings for concentrated cargo loads.

Honeywell Aero... for the best of both



CLIMATE FOR CREATIVITY:

This is an artist's conception of the Air Force space craft Dyna Soar. Honeywell Aero has been selected both as an associate and as a sub-contractor for the critical guidance and flight control subsystems respectively on this delta-winged space craft that will carry one or more astronauts. The Dyna Soar will be sent into space by a Titan booster.

The Dyna Soar project is representative of the many advanced systems which are being evolved and developed into working hardware at Honeywell Aero. It is typical of the type of creative concept that poses a challenge to the engineer or scientist possessing imagination, drive, and talent.

You will find in the Aero division an opportunity to associate with those who understand, appreciate and respond to the creative individual. In the process you will grow in professional stature and have your accomplishments recognized and rewarded.

CLIMATE FOR ENJOYMENT:

Sailing, canoeing, power-boating, water skiing or fishing, you'll find opportunity for all in the Minneapolis area. Within the city limits are three sailboat docks, five canoe docks, and four large lakes for game fishing. A half-hour away lies fabled Lake Minnetonka—"The Land of Sky Blue Water"—more than 200 miles of shoreline and plenty of room to set a tack. Nearby, flow the miles of waterway of the Mississippi River, the Minnesota River, and the St. Croix River. Wonderful areas for outboard or launch cruising, with hidden islands and coves to test your spirit of adventure. These aquatic pleasures are but one facet of the many recreational, social and cultural enjoyments you and your family will share when you work at Honeywell's Aeronautical Division in Minneapolis.

ENGINEERING OPPORTUNITIES:

There are openings for qualified personnel in each of these areas where you'll find a Climate for Creativity and job satisfaction working on a wide diversification of missile, space and advanced aircraft.

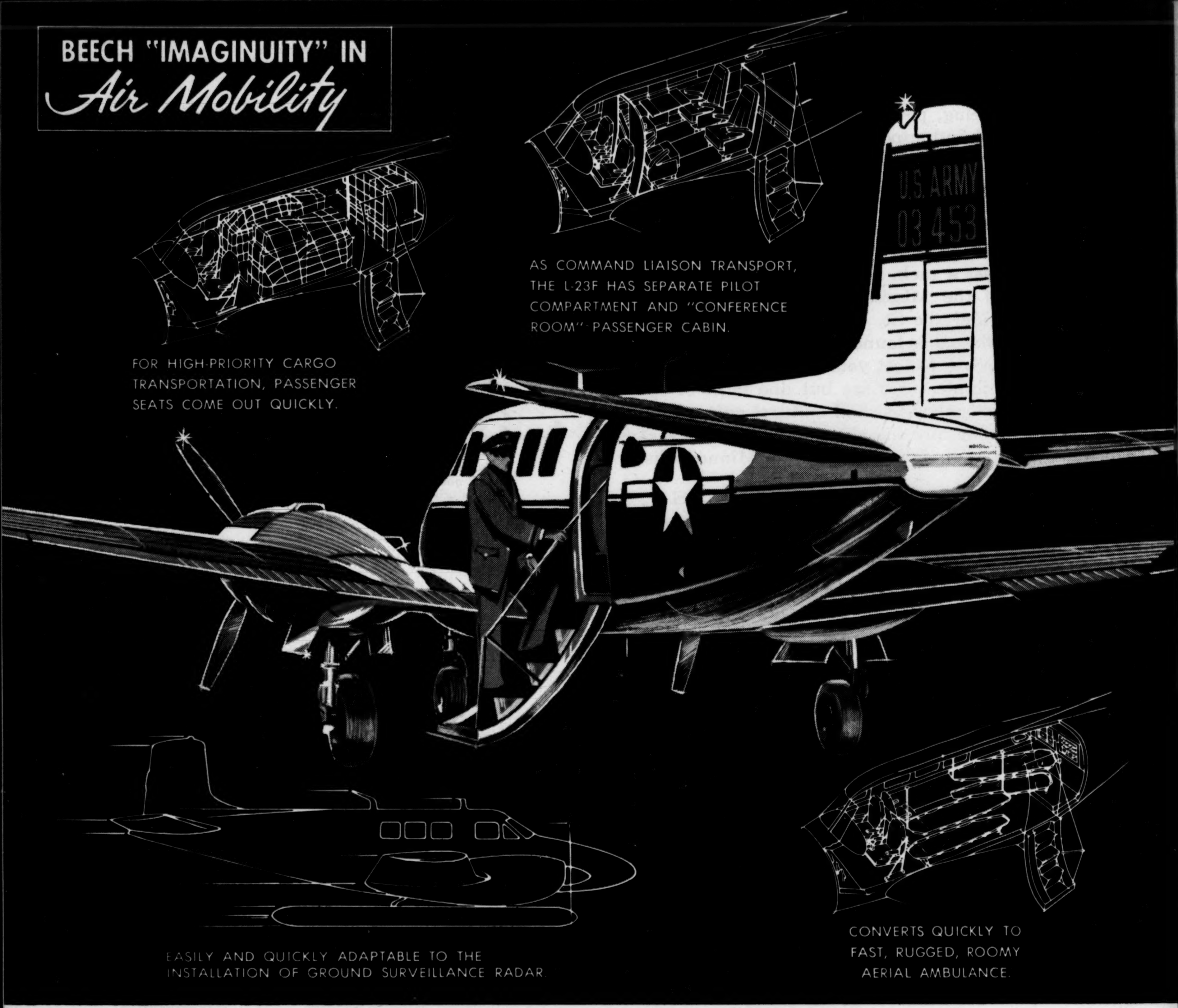
- **Vehicle Structural Design**
- **Propulsion Systems**
- **Power Systems**
- **System Synthesis**
- **Advanced Gyro Design**
- **Flight Control & Reference Systems**
- **Measurements & Display Instrumentation**
- **Ground Support Equipment**
- **Human Factors**
- **Applied Research (in any of the preceding areas)**
- **Evaluation Laboratory**
- **Components, Applications and Standards**
- **Materials Engineering & Physical Chemistry**

Select your area and send your résumé or request for information on specific openings to: Mr. Clyde W. Hansen, Technical Director, Aeronautical Division, 2658 Ridgway Road, Minneapolis 40, Minn.

Honeywell

Military Products Group

To explore professional opportunities in other Honeywell operations, coast to coast, send your application in confidence to: Mr. H. D. Eckstrom, Honeywell, Minneapolis 8, Minnesota. All qualified applicants considered regardless of race, creed, color or national origin.


BEECH "IMAGINUITY" IN
Air Mobility
FOR HIGH-PRIORITY CARGO TRANSPORTATION, PASSENGER SEATS COME OUT QUICKLY.
AS COMMAND LIAISON TRANSPORT, THE L-23F HAS SEPARATE PILOT COMPARTMENT AND "CONFERENCE ROOM" PASSENGER CABIN.
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EASILY AND QUICKLY ADAPTABLE TO THE INSTALLATION OF GROUND SURVEILLANCE RADAR.
CONVERTS QUICKLY TO FAST, RUGGED, ROOMY AERIAL AMBULANCE.

The Beechcraft L-23F meets the need for . . .

Air mobility that combines versatility, high performance and low cost:

The new Beechcraft L-23F offers a combination of advantages found in no other aircraft. With its supercharged fuel injection engines, the L-23F provides fast, comfortable all-weather transportation that can span long distances in a hurry. Yet it is so ruggedly built that it can operate safely even from small, unimproved fields. The L-23F offers air mobility for a wide range of uses at a fraction of the cost of operating larger planes. Quickly and easily adaptable to the installation of ground surveillance radar, the L-23F can also be converted quickly for liaison and cargo missions. Its versatility is further demonstrated by its rapidly growing popularity as a multi-engine instrument trainer.

Beech *Aerospace Division*

BEECH AIRCRAFT CORPORATION • WICHITA 1, KANSAS

Beech Aerospace Division projects include R&D on manned aircraft; missile target and reconnaissance systems; complete missile systems; electronic guidance systems; programs pertaining to liquid hydrogen propellants and cryogenic tankage systems; environmental testing of missile systems and components; and GSE.
May we help you? Write, wire or phone Roy H. McGregor, Manager—Contract Administration, Beech Aircraft Corp., Wichita 1, Kansas—or nearest Area Office.

U. S. Business & Utility Plane Shipments

June 1961

Make and Model	No. of Units	Factory Net Billing
Aero Commander 500A, E	5	
560F	5	$1,096,000
680E, F	3	
Beech 18 Super	0	
33 Debonair	11	
35 Bonanza	25	
50 Twin-Bonanza	1	$2,591,000
55 Baron	22	
65 Queen Air	5	
95 Travel Air	1	
Cessna 150	34	
172, Skyhawk	69	
175, Skylark	8	
180	15	
182, Skylane	40	$3,769,000
185, Skywagon	44	
210	15	
310	13	
T-37B	2*	
Champion 7EC Traveler	5	
7FC Tri-Traveler	2	
7GCB Challenger	10	$126,000
7GCBA Agricultural	2	
7HC DX'er	0	
7KC Olympia	1	
Mooney Mark 21	28	$390,000
Piper PA-18-150 Super Cub	22	
PA-22-108 Colt	129	
PA-22-150 Tri-Pacer	0	
PA-23-160 Apache	6	
PA-23-250 Aztec	17	$2,791,000
PA-24-180 Comanche	9	
PA-24-250 Comanche	24	
PA-25-150 Pawnee	37	
PA-28-160 Cherokee	16	
Totals	626	$10,763,000

* Cessna twin-jet military trainer exports considered commercial business.

Note: Shipments January through June 1961 total 3,625 aircraft having a total factory net billing value of $66,885,000. This compares with 4,412 units having a total billing value of $86,598,000 delivered by the factories in the same period last year. Number of units shipped shows some slippage from May's 637, but dollar volume is up over that month's $10,608,000, due partly to an increase in deliveries from the factories to sales outlets of more expensive models and inclusion of Cessna's T-37B jet trainer export deliveries. Noteworthy has been the continued high pace of two-place Colt deliveries from the Piper plant—685 units in 1961's first six months.

make firm plans for excursions into the hinterlands—with particular emphasis on hunting expeditions.

The Alaska Airlines' sales representation fits in with Lockheed International's effort to promote world-wide distribution of the Lockheed 60. The plane, powered by a 260-hp. Continental TSIO-470 engine, is being produced by Lockheed-Azcarate in Mexico (AW Apr. 17, p. 131), by Aviones Lockheed-Kaiser (AW May 23, 1960, p. 65) in Argentina and by Lockheed's Italian affiliate, Aeronautica Macchi. Lockheed International maintains distribution rights for the utility aircraft in the United States, Canada and Australasia. Azcarate's domain includes everything south of the U. S., excluding Argentina which is in the bailiwick of Kaiser. Macchi is the outlet for all sales in Europe, Africa and the Middle East.

Although Lockheed International will, for the most part, be selling planes built by Azcarate, the five planes pegged for Alaska Airlines were manufactured by Macchi in Milan. The reason, according to Lockheed, is that "current production versus current sales commitments for Azcarate worked out so that they couldn't fill the Alaskan order at this time." For the most part, however, "due to the simple fact of geographic expediency," Lockheed continued, "the planes distributed by our outfit will be produced in Mexico."

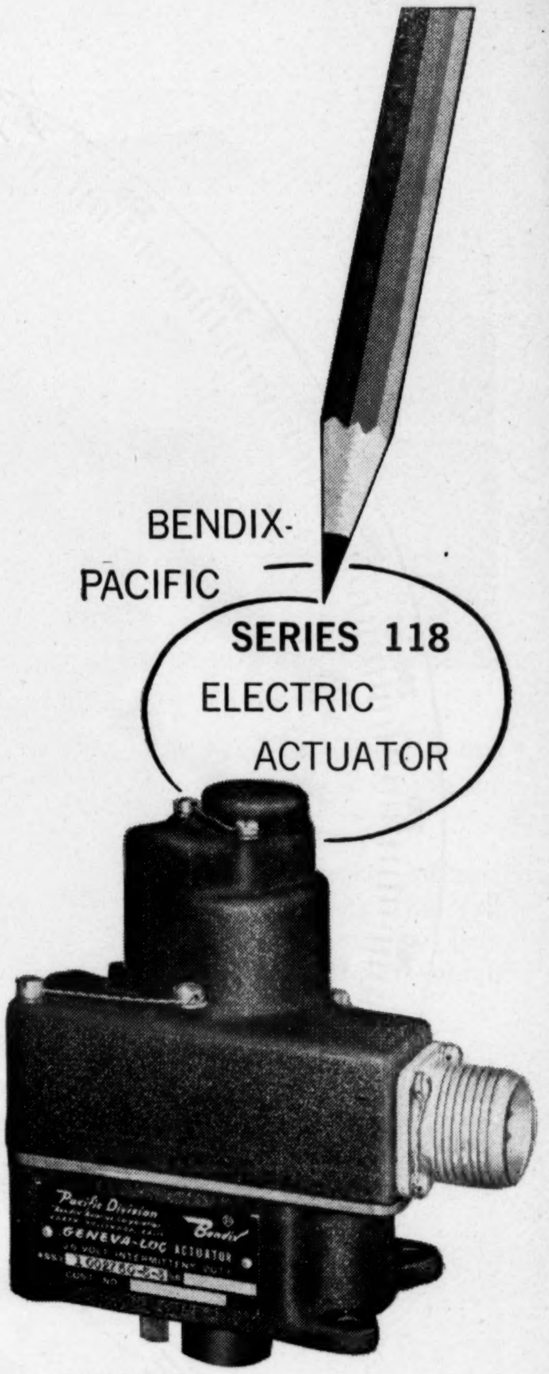
The Macchi-produced aircraft for Alaska Airlines were scheduled to be ferried from Italy to the United States in stages. Aircraft Ferry Co. of Ft. Lauderdale, Fla., has been equipping the 60s with extra fuel tanks. Itinerary includes having the planes flown from Milan to Spain, then to Portugal and the Azores. After alighting at Ft. Lauderdale, the planes are to be delivered to the Pacific Northwest.

Lockheed officials told Aviation Week that the price of the standard 60, fly-away Seattle, is $28,450.

Lockheed says it plans to expand its U. S. dealership network in the near future with "initial emphasis being placed in the West."

Mexico Buys Four Hiller Helicopters

Hiller Aircraft Corp., Palo Alto, Calif., has delivered four helicopters to the Mexican government. These include three 12E three-place aircraft for use in forestry and development of Mexico's hydraulic resources and a four-



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PROVEN IN AIRCRAFT AND MISSILE CONTROL

of fuel, air, and cryogenic valves.

★ Features mechanical positioning, positive lock, unique torque characteristics.

★ Provides unusually high resistance to shock, acceleration and vibration. Weight 17 oz.

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ACTUATORS

Geneva-Loc • Conventional Rotary

Linear • High-Response •

Safe & Arm

TIMERS

Sequential Programming

Repeat Cycle • Adjustable

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WEATHER
SYSTEMS

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. . . HELP AIRCRAFT AVOID STORMS, TURBULENCE AND HEADWINDS

Accurate and flexible enough to use as a scientific instrument, yet rugged and reliable for everyday use, SELENIA WEATHER RADAR is the choice of many European weather services. Write today for the New Selenia Weather Radar Catalogue.

Selenia high-power, low-cost weather radar detects storm formations at great distances. The combination of the Pencil-Beam antenna, flexible scanning modes and calibrated iso-echo gain control quickly determines the altitude and extent of the zones of dangerous precipitation and turbulence. Up-to-the-minute en route weather information can thus be forwarded to pilots in the area.

Inexpensive weather balloons can be automatically tracked with Fire-Control accuracy to determine wind speed and direction at various altitudes. The most economical cruising altitude is readily determined for all routes.

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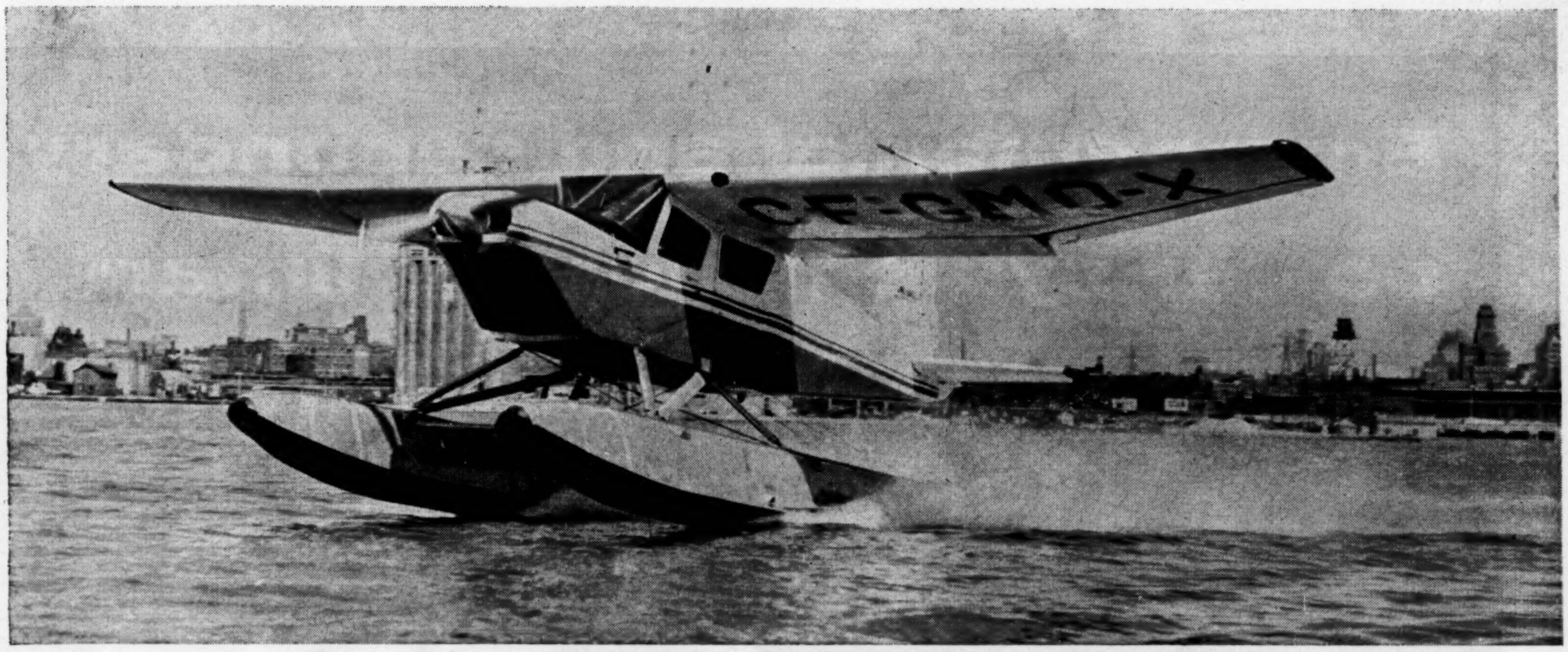


Found Bros. FBA-2 Lightplane Makes Float Test

Found Bros. Aviation, Ltd., Malton, Ontario, Canada is testing its utility FBA-2A with Edo Model 2870 floats. The all metal, four-five place, 250-hp. Lycoming-powered aircraft will be available in a tricycle version, the 2B, or a tailwheel version, the 2C, which is suitable for ski operations. Both configurations, according to the company, can be mounted on floats.

place E4 helicopter for transport of Mexico's president on tours around the country.

One of the 12E's is equipped with a personnel hoist for lowering and retrieving geological engineers in dense jungle areas where even a helicopter cannot land.

Three Hiller 12Es also are being delivered to the Colombian air force for use in public service and law enforcement. The helicopters are equipped with high-compression pistons for high-altitude mountain flying. Two also are equipped with high penetration electronic loudspeakers.

Hiller is delivering one E4 to a sugar production firm, Sociedad Agricola y Industrial, in Ecuador, for use as an executive transport.

Aerocar Negotiating For Sixth Distributor

Ft. Worth, Tex.—Aerocar International has signed distributor contracts covering five sales territories in the U. S. and expects to reach an agreement for a major sales outlet covering Texas and Oklahoma.

Firm distributor-dealer deposits have been obtained to date for more than 350 of the two-place convertible roadable airplanes, Aerocar president Roy Hyde told Aviation Week. He expects that tooling up for production of the airplane can begin shortly. Ling-Temco, with which Aerocar has a production agreement (AW Mar. 27, p. 104) has extended a previous deadline of July 1, by which time 500 orders were to have been in, for another six months and there is to be no increase in the original price. Hyde expects that tooling up will be completed in time to have demonstrator Aerocars available to distributors and dealers by the end of the year. Firm territories now given by Aerocar include Washington, Oregon, Idaho, California and Michigan.

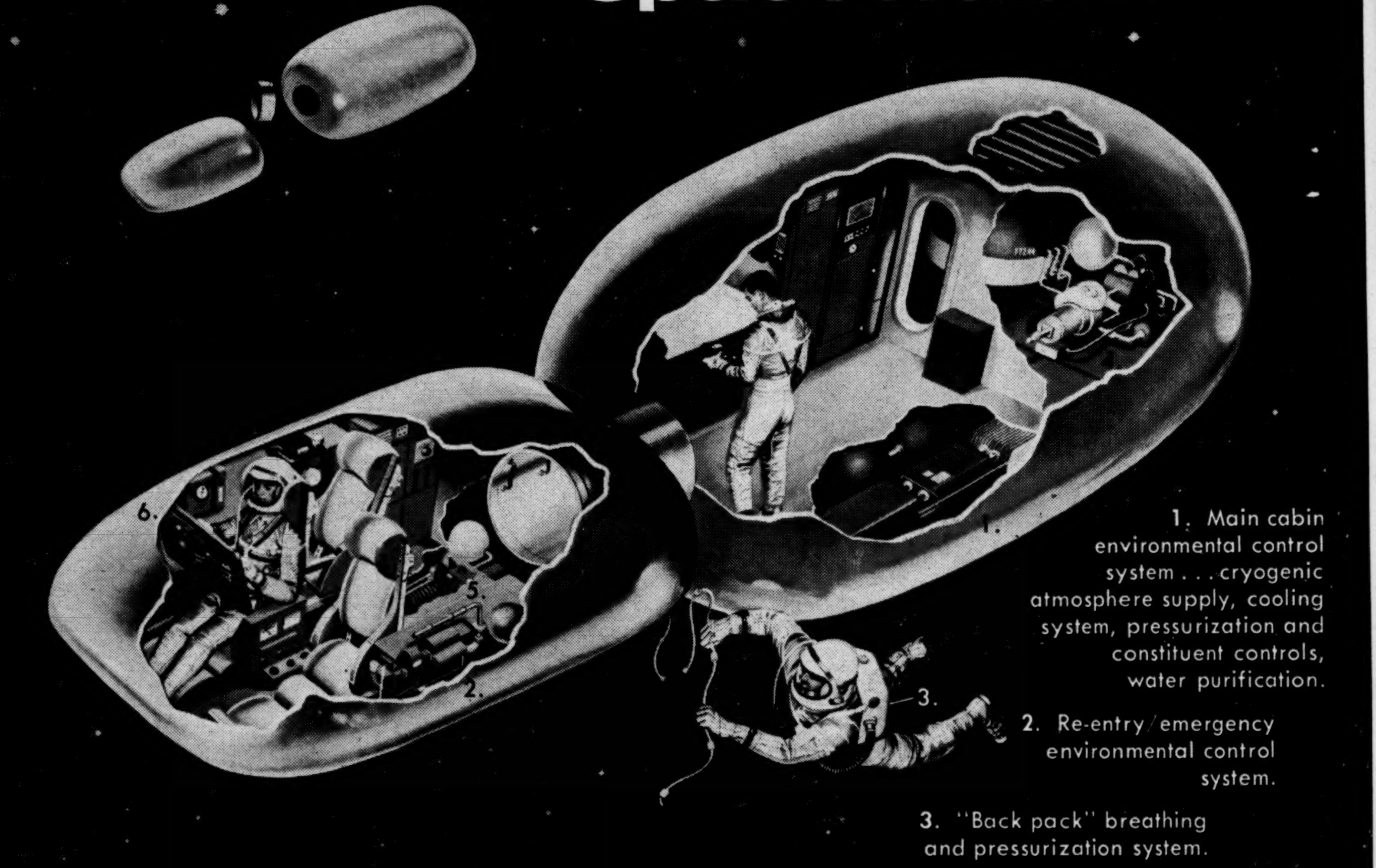
Major build-up in national interest is expected by the company this fall when television actor-producer Bob Cummings starts his new series, which will feature the Aerocar.

STULL
STULL CHEMICAL CO.

Helicopter Kit Sprays Field in 20-mph. Wind

Drift-resistant helicopter spray kit, patented by Stull Chemical Co., San Antonio, Tex., applies herbicides in a "mayonnaise-like" consistency capable of being sprayed in a 20-mph. wind. "Low-drift" herbicide is a product of an invert emulsion of water in oil-herbicide mixed in a specially designed nozzle. Certificated for the Bell 47D, D-1, G, G-2, G-2A and G-3B helicopters, the spray kit consists of a bifluid process system of two tanks—one holding water, the other oil and chemicals. Each tank has a feed line to the nozzles where the components are mixed and the invert emulsion formed. Nozzles eject the emulsion in uniform, 200 micron droplets. Flow rate is metered at the nozzle with a control maintained over the mixture consistency. Kit includes two 40 or 60 gal. tanks, two electric pump units (one for each tank assembly), and a three-section spray boom equipped with 46 nozzle outlets that delivers a maximum swath width of 60 ft. at normal spraying altitudes. Pressure gages for each pump assembly are located on a separate panel in the helicopter's cockpit.

Environmental and secondary power systems for multiman spacecraft...



1. Main cabin environmental control system . . . cryogenic atmosphere supply, cooling system, pressurization and constituent controls, water purification.

2. Re-entry/emergency environmental control system.

3. "Back pack" breathing and pressurization system.

4. Secondary power system . . . multiple re-entry turbine, pump, alternator and cryogenic fuel supplies.

5. Attitude control system . . . reaction motor, fuel and attitude controls.

6. Instrumentation . . . flight data and physiological monitoring systems.

Manned space flight requires reliable and efficient thermal and atmospheric systems and secondary power equipment.

Complete and integrated systems, as pictured, are being studied or under development at The Garrett Corporation. Through optimized design they offer an unmatched degree of compatibility and high performance.

Their design reflects Garrett's 20 years of leadership in developing and producing secondary power and environmental controls for aircraft and spacecraft, including NASA's Project Mercury life support system. This unique capability offers an unequaled source of research, development and production to the government and industry.

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AiResearch Manufacturing Divisions

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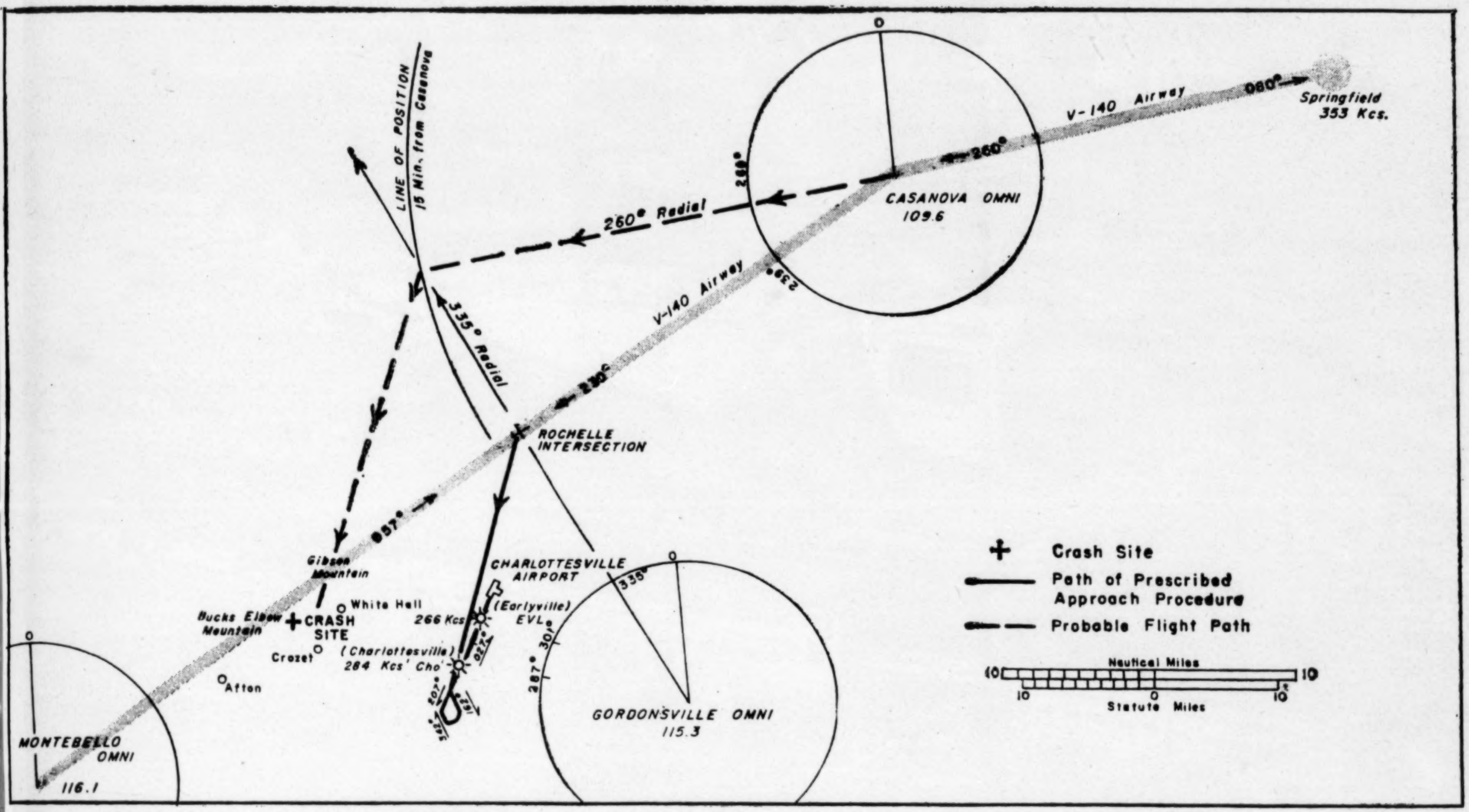
Systems and Components for: AIRCRAFT, MISSILE, SPACECRAFT, ELECTRONIC, NUCLEAR AND INDUSTRIAL APPLICATIONS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LINE OF POSITION
15 Min. from Casanova
V-140 Airway
080°
Springfield
353 Kcs.
260°
269°
260° Radial
CASANOVA OMNI
109.6
V-140 Airway
239°
335° Radial
230°
ROCHELLE
INTERSECTION
057°
Gibson
Mountain
CHARLOTTESVILLE
AIRPORT
White Hall
Bucks Elbow
Mountain
CRASH
SITE
266 Kcs
(Earlyville)
EVL
Crozet
(Charlottesville)
284 Kcs' Cho'
Afton
027°
207°
162°
342°
335°
287°
301
0
GORDONSVILLE OMNI
115.3
MONTEBELLO
OMNI
116.1
0
Crash Site
Path of Prescribed
Approach Procedure
Probable Flight Path
Nautical Miles
10
0
10
Statute Miles
10
0
10

MAP OF AREA shows correct and probable flight paths of DC-3. Note intersections formed by 335-deg. radial of Gordonsville omni.

CAB Accident Investigation Report—Part I:

Navigation Error Cited in Piedmont Crash

About 2040, Oct. 30, 1959, Piedmont Airlines Flight 349 crashed on Bucks Elbow Mountain located about 13 mi. west of the Charlottesville-Albemarle County, Va., Airport. The crew of 3 and 23 of 24 passengers were killed; the sole survivor was seriously injured. The aircraft, a DC-3, N 55V, was demolished by impact.

From the available evidence it is the determination of the Board that this accident occurred during an intended instrument approach. More specifically, it occurred during the inbound portion of the procedure turn which was being flown 8 to 11 mi. west of the maneuvering area prescribed by the instrument approach procedure.

The Board concludes that the lateral error resulted from a navigational omission which took place when the pilot did not turn left about 20 deg. in conformity to V-140 airway at the Casanova omni range station. Consequently, when the pilots believed the flight was over the Rochelle intersection it was in fact 13 mi. northwest of that position. As a result of this position, when the pilot turned left and flew the heading normally flown from Rochelle intersection, the path of the aircraft over the ground was displaced 8 to 11 mi. west of the prescribed track. The Board further concludes that the error was undetected because tracking and other instrument approach requirements were not followed precisely.

From information regarding the personal background of Capt. Lavrinc and expert medical analysis of this information, it is the Board's opinion that preoccupation resulting from mental stress may have been a contributing factor in the accident cause.

INVESTIGATION

Piedmont Airlines Flight 349 was a regularly scheduled flight between Washington, D. C., and Roanoke, Va., with intermediate stops at Charlottesville and Lynchburg, Va. On Oct. 30, 1959, the assigned flight crew consisted of Capt. George Lavrinc, First Officer Bascom Haley, and Purser George Hicks.

The aircraft departed Washington at 1949.[1] It was about 20 min. behind schedule, the result of traffic, ground, and ramp delays. The flight was according to an instrument flight plan and clearance which specified a routing over airway V-140 and a cruising altitude of 4,000 ft.[2] At departure the gross takeoff weight of DC-3, N 55V, was 25,346 lb., which was also the maximum allowable weight. The load was properly distributed.

The flight made a Georgetown departure and then proceeded to the Springfield, Va., radio beacon where it entered V-140 airway. It followed the airway from Springfield to Casanova omni range station. The centerline of the airway over this segment is defined as the 260-deg. radial of the Casanova omni. At 2012[3] Flight 349 reported that it was over Casanova at 2010. It also reported it was at 4,000 ft. and estimating the Rochelle intersection at 2024, with Charlottesville next.

At Casanova, V-140 airway turns left and from Casanova to the Rochelle intersection the airway is defined as the 239-deg. radial of Casanova omni; the distance is 31 mi.[4] The Rochelle intersection is the 239-deg. radial of the Casanova omni and the 335-deg. radial of the Gordonsville omni.

About 2018 Flight 349 made a routine in-range report to the Piedmont ground radio station located at the Charlottesville Airport. The flight informed the company that it was in range, IFR (instrument flight rules), and would have 250 gal. of fuel on board when it departed Charlottesville for Lynchburg. The radio operator furnished the flight the latest altimeter setting, 30.47, and the current surface wind which was calm. Normally, the operator would also furnish the latest ceiling and visibility observation. This, according to his testimony, he failed to do. The current observation at this time was: Ceiling, measured 1,500 ft. broken, 4,000 ft. overcast; visibility 10 mi.

Immediately after 2025 the flight reported

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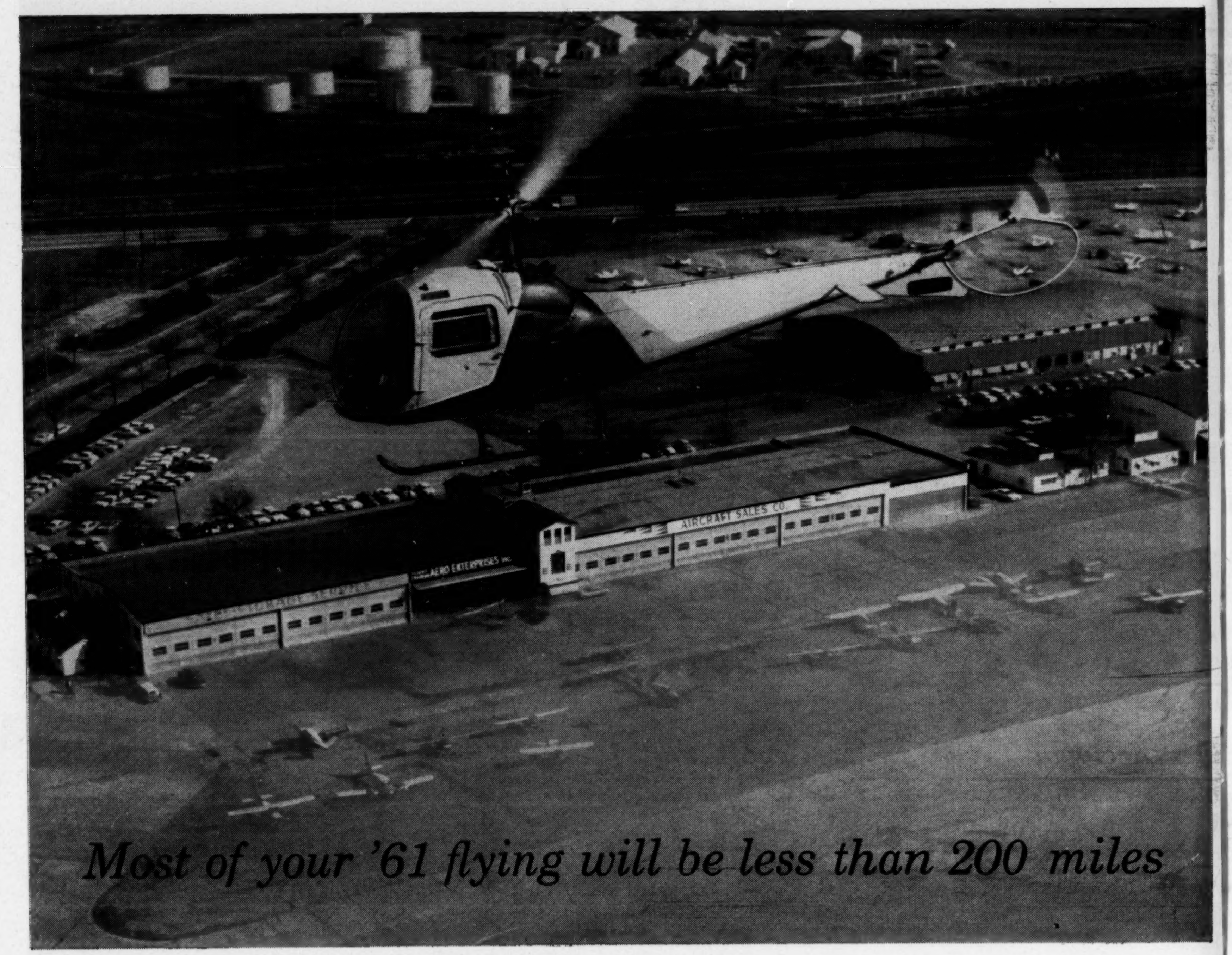
[1] All times herein are eastern standard based on the 24-hr. clock.

[2] Altitudes are mean sea level unless otherwise stated. Weather reports of ceiling and cloud levels are feet above the ground.

[3] Reporting times were determined by timing the recordings of the transmissions and are accurate within one minute. Voice identification from the recordings showed the radio transmissions were made by First Officer Haley, thus indicating that Capt. Lavrinc was flying the aircraft.

[4] Distances are nautical miles.



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to the Washington Air Traffic Control Center that it was over the Rochelle intersection at 2025 at 4,000 ft. and estimating the Charlottesville Airport at 2030. Washington Center acknowledged and cleared Flight 349 for an instrument approach. About one minute later the flight informed the center as follows, "You can put us out of four thousand." This was the last transmission from the aircraft.

Investigation revealed the weather observations for Charlottesville were: at 1900, 1,700 ft. scattered, ceiling 4,000 ft. overcast, visibility 10 mi.; at 1930, ceiling 1,700 ft. broken, 4,000 overcast; at 2000, ceiling measured 1,500 ft. broken, 4,000 ft. overcast, visibility 10 mi., wind calm; at 2100, ceiling measured 1,500 ft. broken, 2,400 ft. overcast, visibility 10 mi., wind calm. A study of the weather observations from other stations in the area showed the Charlottesville conditions should have been substantially as reported. The situation, however, showed that conditions would be much worse in the area near and parallel to the mountains west of Charlottesville. In this area the mountains were obscured and visual flight would not have been possible.

Studies of the winds aloft by the U. S. Weather Bureau showed that at altitudes used by Flight 349 they were predominantly southerly and averaged about 15 kt.

Radio Search

When the flight did not land as anticipated a radio search was made, which proved futile. A ground search was begun as quickly as possible and supplemented by an air search the next day. Throughout that day both were seriously hampered by bad weather. On Nov. 1, about 0800, the wreckage was sighted from a helicopter on the southern slope of Bucks Elbow Mountain, which is located about 13 mi. west of the Charlottesville Airport. It was almost hidden by dense tree cover.

Investigation at the scene showed the aircraft crashed where the upslope of the 3,100-ft. mountain was nearly 30 deg. It crashed against the rocky slope on a magnetic heading of 340-350 deg. and at an elevation of approximately 2,600 ft. Initial contact occurred when the right wing of N 55V struck and cut through several trees which progressively tore off the right wing outboard of the landing light. At initial impact the right wing was down about 10 deg. from level and the the aircraft was descending slightly. The aircraft was yawed to the right and rolled to the right when, about 180 ft. farther, it crashed against the upslope.

In the final impact the forward fuselage rearward to the center section was destroyed. The fuselage was broken from the center section and displaced to the left so it rested on the left wing outboard of the attach angle. The fuselage was also cocked to the left about 45 deg. relative to the center section. Most of the fuselage from over the center section rearward to the cabin door was destroyed or badly crushed. All of the passenger seats were torn from the floor, including the one in which the surviving passenger remained fastened when he was thrown clear of the fuselage.

The structural investigation determined that the landing gear was extended at impact and the flaps were fully retracted. Also, although the aircraft sustained great damage, it was reliably determined that there was no malfunction or failure of the aircraft prior to impact.

Examination of the engines and propellers disclosed no evidence of malfunction prior to impact. Evidence showed that both engines were operating and developing appreciable power when the aircraft struck the mountain; the specific amount of power, however, could not be determined. Evidence also showed that at that time both propellers were capable of normal operation. Examination and bench checks where required and showed the engine accessories were capable of normal operation before the impact.

Mr. Phil Bradley, the sole survivor, stated that the flight seemed perfectly normal until the crash. His description of the weather indicated that except for the initial portion, the flight was made in instrument weather conditions. He noted this when he periodically peered through the cabin window from his seat. He also noted reflected light from the anticollision light. Mr. Bradley stated the flight was a little rough and except for a short period following takeoff the "fasten seat belt" sign was on until the crash.

The survivor stated there was no indication of any difficulty. He said the cabin lights were on and the engines sounded normal. He said that a few minutes before and at the time of the crash the cabin was quiet and all passengers were seated. He said both pilots were in the pilot compartment and the purser was attending to his duties.

Mr. Bradley said the plane made several turns, although he was not sure of the amount or direction. One such turn, and seemingly the largest, occurred a few minutes before the crash. He, at first, thought the turn was about 180 deg. but later felt it was more in the order of 90 deg.

The witness said he had just folded his arms and was looking at his wrist watch when the crash occurred; it was 2040. He said his watch was an accurate timepiece and he had checked it against an airport clock earlier that day. In this connection, other watches were recovered and some had been impact stopped. These showed various times which bracketed 2040.

The approach procedure for the Charlottesville Airport is an ADF (automatic direction finder) procedure performed on a Piedmont-owned and operated homer beacon facility. The night landing minima for Piedmont DC-3 aircraft are: Ceiling 400 ft.; visibility 1 mi.

The current Federal Aviation Agency (FAA) approach procedure as applicable to Flight 349 would begin at the Rochelle intersection. According to the procedure in effect at the time of the accident, when Rochelle was reached the flight would transition off V-140 airway in a left turn to a heading of 212 deg. It would then establish and fly a 212-deg. track to the Charlottesville (CHO) homer beacon, which transmits on 284 kcs. As an additional aid, though not required, the company owns and operates another homer beacon, Earlyville (EVL), which transmits on 266 kcs. Charlottesville, the outer homer, is located 4.3 naut. mi. from the approach end of runway 3 and 15.5 mi. from the Rochelle intersection.

In normal execution of the instrument procedure most Piedmont pilots use both homer facilities, tuning one ADF to the

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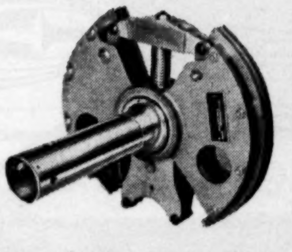

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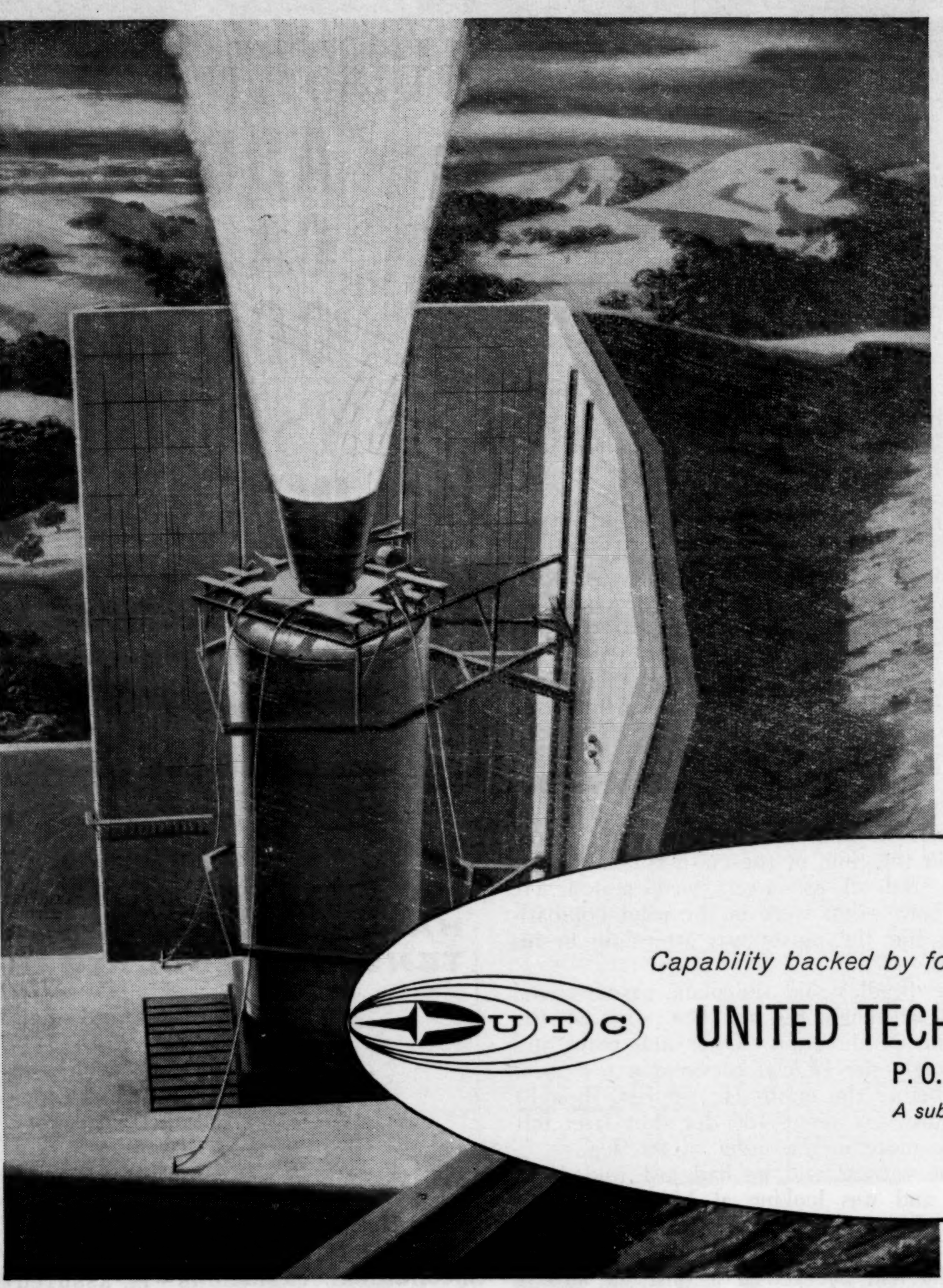

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Charlottesville homer, 284 kcs., and the other to the Earlyville beacon, 266 kcs. In addition, many of the pilots also check passage of the Charlottesville homer by using the Gordonsville omni, set to the 287-deg. radial which passes through the homer. Some, at the same time, also check passage of the Earlyville facility by using the second omni set, tuned to the 301-deg. radial of Gordonsville.

When Board investigators attempted to plot the Rochelle intersection and airport locations, it was noted that the magnetic heading from Rochelle to the Charlottesville homer, as depicted on the ACA Form 511 and thus on the approach plate, was in error. The correct heading should have been 201 deg. instead of 212. The error resulted from not amending the heading when, several months earlier, the course of V-140 airway was shifted slightly. In this accident the error loses significance because, according to the flight plan for Trip 349, the correct heading was used. Further, the use of tracking procedures in flight would eliminate the effect of the erroneous heading. Nevertheless, the attention of both the FAA and the company was immediately directed to the error for correction.

According to the instrument approach procedure, upon reaching the Charlottesville homer beacon an outbound track of 207 deg. should be flown, normally for 1 to 1½ min. This is followed by a standard procedure turn on the southeast side of the track. Using the standard procedure turn, the outbound heading is 162 deg. and the inbound heading is 342 deg. The final approach track to the airport is 027 deg.

Descent below 3,000 ft. is not authorized prior to the final approach; then a descent is permitted to not less than 2,200 ft. before reaching the Charlottesville homer. Thereafter, descent may be continued to the authorized minimum altitude of 1,039 ft., or 400 ft. above airport elevation.

From the Rochelle intersection the entire instrument approach to landing in the DC-3 takes approximately 15 min. From Rochelle to the inbound heading of the procedure turn about 10-11 min. time is normally required. It appears important to note that based on the reported time of Flight 349 over Rochelle, 2025, and the crash time indicated by Mr. Bradley, 2040, the elapsed time was approximately 15 min.

Navigational Equipment

Although the radio and navigational equipment from N 55V was badly damaged and some portions were destroyed, information which was important to the investigation was available. Examination of the omni equipment disclosed that both receivers were tuned to 115.3 mcs., the Gordonsville omni range frequency. It was also learned that the right omni bearing indicator was set to select the 301-deg. radial or, as previously indicated, the radial which passes through the Earlyville homer. The radial selected on the other unit could not be determined.

Examination of the various components of the red and green ADF units disclosed both receivers were positioned to select band 1, the 200-410 kc. range. It was determined that the red ADF unit was tuned to 265 kcs., or approximately the frequency of the Earlyville homer, 266 kcs. Impac damage to the green ADF made the mos reliable indication of the frequency setting the position of the frequency selector. This, slightly damaged and locked in position, was set on 286 kcs., or close to the frequency of the Charlottesville homer, 284 kcs.

Examination of the ADF loop assemblies revealed that the position of the red ADF loop was equivalent to a bearing of 91 deg. on the cockpit needle. On the same basis the green ADF was positioned on a bearing of 112 deg. The loop positions are most reliable as to the positions of the needles on the ADF instrument; however, this cockpit instrument, except the face, was destroyed. It is significant that with the aircraft on the crash heading of about 345 deg. the bearings of 91 and 112 deg. extended from the crash site pass very close to the Earlyville and Charlottesville homer locations, respectively. Further, the 21-deg. angle between the loop bearings extended from the accident site to the radio facilities subtends an arc equal in miles to the distance between the homers.

Both aircraft altimeters were found. The right indicated an altitude of 9,200 ft. and was set to a barometric setting of 30.43. The left instrument showed about 2,520 ft. and a barometric setting of 30.40. The elevation of the accident location was 2,600 ft. The last altimeter setting given the flight was 30.47. Other flight instruments were damaged to such an extent that no useful information was obtained.

An exhaustive flight check was made of all of the various navigational ground facilities pertinent to Flight 349. The checks

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PROBLEMATICAL RECREATIONS 79

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This year's WESCON will be held concurrently with the conference of the International Astronomical Union, reflecting the marriage of electronics and astronomy. Among the galaxy of booths at San Francisco's Cow Palace, August 22-25th, will be the many divisions of Litton Industries. A welcome of the first magnitude is extended to all.

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were made to determine what, if any, condition existed which might have led the flight into the mountain, or if the facilities were functioning within FAA operating standards. To this end nearly 25 hr. were flown on the facilities. The checks were flown shortly after the accident and at various times, night and day, thereafter. With Board investigators aboard, they were flown by the FAA Flight Inspection Branch using an especially equipped aircraft for the purpose, by the FAA Air Carrier Branch, and by Piedmont in its own equipment. No discrepancies were found.

In addition, at the request of the Board, the Federal Communications Commission entered the investigation. With special equipment and expert personnel, investigation was made to determine if there existed any ground phenomena, including the operation of electronic equipment in the local area, which could adversely affect the normal operation of the facilities. Signal strength for proper reception was measured in appropriate areas, a search for a reported unauthorized homer was conducted, and the possibility of spurious radio signals was investigated. After the work was completed, the spokesman for the FCC team said nothing was found which would preclude or seriously impair the normal operation of the approach facilities.

Witnesses' Reports

An intense search resulted in the finding of a series of ground witnesses who had heard a low-flying aircraft. Because of weather conditions, consistently described as cloudy and foggy, none had seen the airplane but a flight pattern based upon the aircraft engines' sound was revealed. For several reasons the soundpath was attributable to Flight 349. Most important of the reasons was that the sound proceeded to and stopped abruptly in the accident area. Other reasons were the coincidence of time when the aircraft was heard with the estimated progress of Flight 349, the knowledge that no other known aircraft operated coincident with the soundpath, and to some degree the correlation between the sound movement and Mr. Bradley's recollections. Because the path was 8-11 mi. west of the airport, a final reason was added when at least three persons on the airport listening for Flight 349 stated they did not hear it.

The aircraft was heard by the series of witnesses between 2020-2045. The first of the series were located 8-10 mi. northeast of the accident location. One of them, located on high terrain near Gibson Mountain, stated the aircraft passed over on a westerly heading and it was so low "it rattled the trees." Other witnesses were positioned along a south-southwest line which was approximately parallel to but 8-11 mi. west of the normal approach path from Rochelle to the airport. Most of these witnesses said the engines sounded normal but as if the aircraft were low. Several in the area of White Hall, Crozet, and Afton heard the plane approaching from the northeast. They indicated that from the sound the aircraft then made a turn from the southwesterly heading to a northwesterly heading and proceeded in the direction of Bucks Elbow Mountain. The direction of the turn was uncertain. . . . (*The concluding part of this CAB Accident Report will appear in a subsequent issue of* Aviation Week.)

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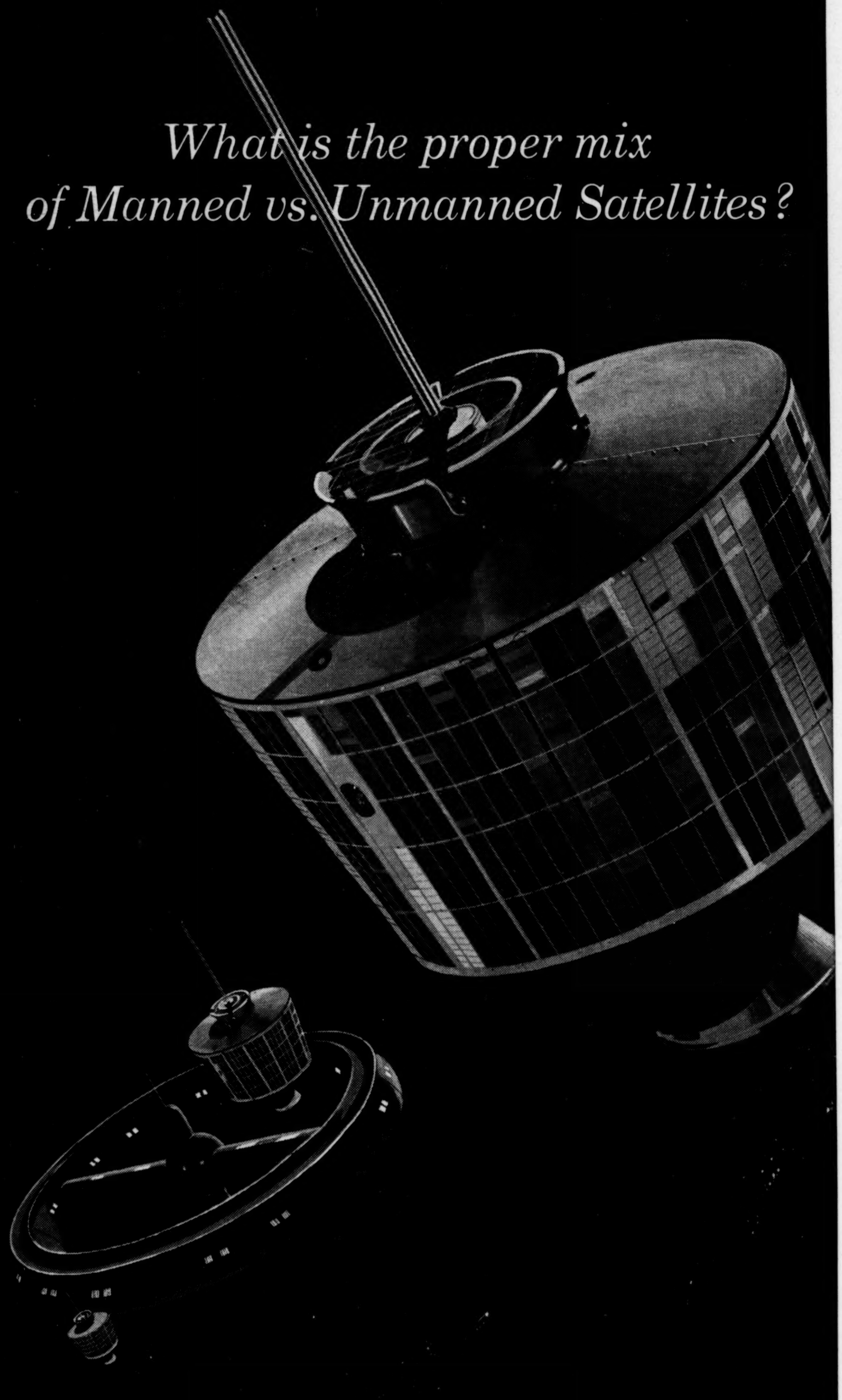
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WHO'S WHERE

(Continued from page 23)

Honors and Elections

Frederick B. Lee has been appointed chairman of the National Safety Council's new General Aviation Safety Committee. Mr. Lee, former Civil Aeronautics Administrator, is now director of Olin Mathieson Chemical Corp.'s Washington, D. C., office.

Arch T. Colwell has been elected as a Fellow of the Royal Aeronautical Society of England. Mr. Colwell recently retired as vice president-engineering, research and development of Thompson Ramo Wooldridge, Inc., but continues as a director and consultant.

Changes

Royal Weller, director of engineering, Space Systems Division of Lockheed Missiles and Space Co., Sunnyvale, Calif.

Charles H. Jackson, staff engineer-ordnance products and systems, Hi-Shear Corp., Manhattan Beach, Calif.

Marc A. Nerenstone and **Vernon E. Palmour** have joined the Washington, D. C., research staff of the Operations Evaluation Group, a part of the Division of Sponsored Research of MIT.

Dr. Artur Mager, assistant director of spacecraft sciences, Systems Research and Planning Division, Aerospace Corp., Los Angeles, Calif.

John Vlad, director-instrument and system sales, International Division of Lear, Inc., with offices in Paris, France.

Timothy Trott, director of engineering, Autometric Corp., New York, N. Y., and **Arthur Edelstein**, chief engineer, Optical-Mechanical Department.

T. Gordon Hame, manager-advanced development for communications, Military Products Division, General Dynamics/Electronics, Rochester, N. Y.

William H. Enders, manager-advanced projects, Aerospace Communications and Controls Division, Defense Electronic Products, Radio Corp. of America, Burlington, Mass.

George M. Leitch, special assistant to the general operations manager, Electronics Operations, Aeronutronic Division of Ford Motor Co., Newport Beach, Calif.

E. J. Venaglia, manager-Atlantic Missile Range modernization program, Sperry Rand Corp., New York, N. Y.

R. G. Fisher, project manager for the Dyna-Soar program, and **I. H. Moore**, project manager for the Boeing 727 program, Westinghouse Aerospace Electrical Department, Lima, Ohio.

Robert E. Lister, business development administrator, Lockheed Aircraft Service, Jamaica, N. Y.

Joseph L. LaMarca, manager of the newly created International Operation, General Electric Co.'s Large Jet Engine Department, Evendale, Ohio.

Dr. Robert Bromberg, director, Mechanics Division; Research and Engineering, Space Technology Laboratories, Inc., Los Angeles, Calif.

Dr. James N. Waggoner, aerospace medical director, The Garrett Corp., Los Angeles, Calif.

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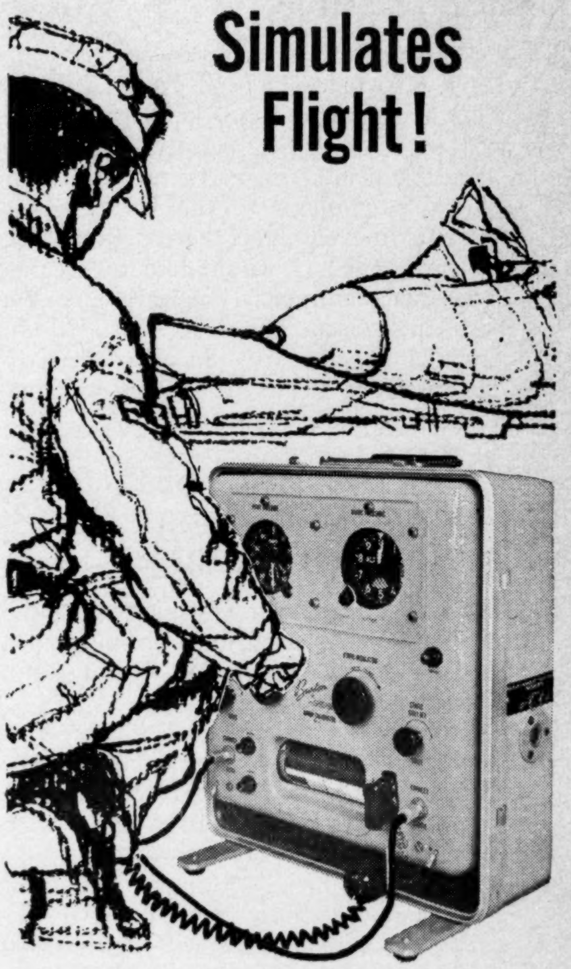
One Man...
One Unit
Simulates
Flight!



Burton FLIGHT CALIBRATOR

checks out all pressure and vacuum equipment...

In pre-flight or maintenance applications, one man with this one portable unit, the new Burton Pitot-Static Tester, can check out and calibrate all pressure and vacuum equipment on high performance aircraft with precision and accuracy. In-flight conditions encountered by precision instruments are reproduced with high accuracy and repeatability in these ranges: Altitude, −1000 to +80,000 feet; airspeed, 0-850 knots; Mach number, .3 to 2.2. Built-in, automatic safety features prevent damage to critical instruments; use of dry pump prevents oil contamination. Portable case contains precision aircraft instruments, pressure and vacuum pump, valves, regulators, hoses, electrical cable; weighs 60 pounds total. Unit operates on 115 vac, single phase, with automatic selection of 50/60 or 400 cycles.

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LETTERS

Bag Tanks

By coincidence, I was reading the letter from H. G. Muff (Jet Fuel Tanks, July 10, p. 112) at the same time the first news appeared on TV of the unfortunate United DC-8 accident in Denver. To me this added considerable emphasis to the letter.

As an airline passenger having flown regularly since 1942, I would like to see the designers of commercial aircraft give the utmost in consideration to Mr. Muff's theory that bag tanks would add materially to the safety of airline passengers in emergency landing and crash situations.

L. W. Darling
Silverlake, Ohio

Parachute Meet

I have just read your editorials reprinted in the National Aeronautics Assn. magazine, entitled "New Image at Paris" and "Our Best Foot Forward."

You are to be commended for presenting such a vivid and accurate appraisal of the problems and importance of maintaining United States prestige in our struggles with Russia.

In August of 1962, at the invitation of Congress and over the protest of the Soviet Union, the United States will be host to 15 or more nations of the world for the Sixth World Sport Parachuting Championship. This will be the largest international aviation competition ever held on the Western Hemisphere.

Parachuting is relatively new as a sport, but it comes as no surprise that Russia already dominates in the field of international parachuting competition. There seems to be no doubt in the minds of leaders of Soviet bloc nations that dominance in this field is important to national defense, to the physical fitness of the people and for propaganda value.

Three of the five previous world parachuting championships have been held behind the Iron Curtain. These events have been extremely well organized, well run elaborate sport spectacles attracting as many as 600,000 people.

In 1962, the young United States team will be in a favorable position to upset the Soviet applecart. In 1960 it nearly did but was forced into fourth place by injuries. The United States jumpers took a gold and silver medal.

The organizers of the championship have in the past months gained the interest of many private citizens and government and military officials. Unfortunately, it might be a case of too few, too late.

There is presently legislation before Congress requesting aid to the championship. It can be that this bill will not pass before Congress adjourns. If this happens, we will perhaps have lost another opportunity to put "our best foot forward."

Robert A. Spatola
Executive Secretary
Sport Parachuting
Commission
Orange, Mass.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Cobra Junction Box

The otherwise excellent article by Cecil Brownlow in the July 24 issue, entitled "Bölkow Pushes Cobra as NATO Missile," contains a small error.

On p. 67 the penultimate paragraph, third column, reads in part: "In the field, an infantryman can carry a loaded container in each hand, with the control unit, 26.1-lb. junction box and an additional reel of cable slung over his back."

The cable with the reel weighs 26.1 lb. The weight of the junction box alone is 0.7 lb. and not 26.1 lb. as stated in your article.

Robert J. Maroni
Director of Military Marketing
Daystrom, Inc.
Murray Hill, N. J.

Soviet Aircraft

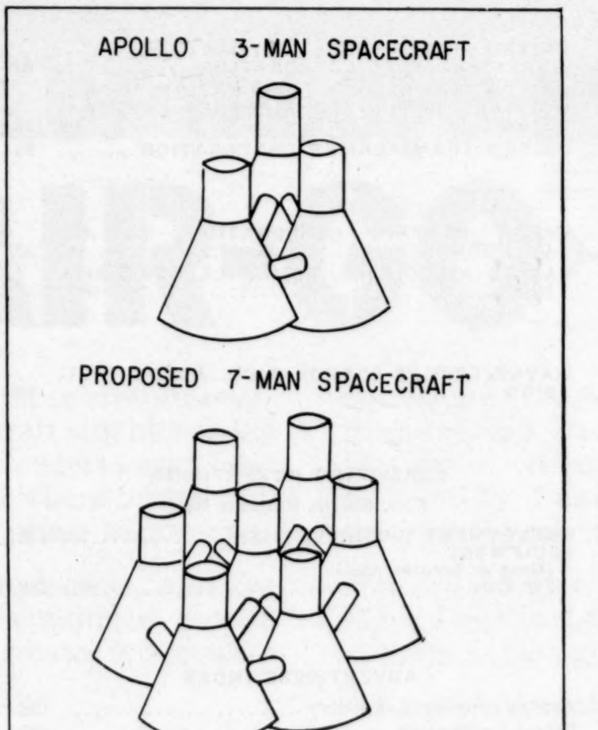
Those Soviets must be even more clever than we all thought after seeing the splendid pictures from Tushino (for which, many thanks).

Now, not only does Mr. James A. Martin detect nuclear nacelles on the Bounder (AW July 31, p. 112), but we learn from a caption (p. 37) that fairings projecting from the Tu-124 wing trailing edge are area rule bulges probably containing fuel.

Deceived by seeing the earlier Tu-104, from which the Tu-124 is derived, we had until now been grievously misled into thinking that these fairings merely covered the retracted main undercarriage units. Clearly, the Tu-104s were built to confuse Western observers and conceal the discovery of what in the U.S. are called "Whitcomb bumps" and in the U.K. are known as "Küchemann carrots." Could these be "Khrushchev corn cobs" or "Tupolev tarradiddles?"

The aviation world awaits with breathless expectation the first photographs of the Tu-124 operating with only a nosewheel to sustain it on the ground. Could this indicate a breakthrough in electro-gravitics?

David W. H. Godfrey
Montreal, Canada


APOLLO 3-MAN SPACECRAFT
PROPOSED 7-MAN SPACECRAFT
ADVANTAGES
1. Should be attractive to NASA, as it makes maximum use of their MERCURY experience
2. Has unlimited growth potential.

FOUND IN THE MAIL: An unsolicited design proposal from an unspecified contractor.

Youth Market

The need of U. S. air carriers across the North Atlantic is to open up untouched passenger markets, not to rework old ones. At the same time, the U. S. teenager belongs to a family of unprecedented prosperity which is able to support an expanding billion-dollar market for such optional expenditures as phonograph records and sports equipment.

Increasingly, both the U. S. economy and its law are combining to shrink opportunities for youth to obtain summer employment. Families are open to persuasion by appropriate advertising efforts to give young people a chance at international travel, if the cost approximates that of an ordinary eight weeks domestic camp, $400 to $800 (see AW Aug. 7, p. 37).

Night flight "steerage-class" transatlantic transportation is acceptable to young people who expect to use youth hostel facilities in traveling, either escorted or unchaperoned, through Europe.

Planeloads of fellow students from the same high school or college would find this a more memorable expenditure than most that they are now making.

It's up to the airlines to sell them.

R. E. Dynes
Beverly Hills, Calif.

Wrong Jet Engine

Just a short note to point out an error on p. 82 of your July 17 issue. Shouldn't the caption under the top picture read: "General Electric CJ805-3 (or maybe CJ805-3B) turbojet with thrust reverser and sound suppressor is shown on the factory floor at Evendale plant."

Bernard Levine
General Electric Co.
Missile & Space Vehicle Dept.
Philadelphia, Pa.

(Reader Levine, a former employe at GE's Evendale, Ohio, facility, is correct. The engine in the photo is a CJ805-3, not a -23 as stated; the photo was taken at the Evendale plant.—Ed.)